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NEPTUNE 5
NEPTUNE 7

ALTO®
Why Compromise™

Service Manual

Wap
KEW
TECHNOLOGIES

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Preface

This service manual contains a detailed description of the main repair work on the hot HPW NEPTUNE 5 and NEPTUNE 7.

Repair work requires a suitable testing workplace with the necessary power supply.

If operating errors are evident, refer the customer to the operating instructions.

A fault in the cleaner can have several causes as described in the section on troubleshooting.

Refer to the illustrated spare parts lists during repairs. They show the assembly position and the sequence in which the individual components should be assembled.

See "Service / Technical Information" sheets. They include information on technical modifications that have been made after this repair manual was printed.

“Service / Technical Information” sheets are also valid as a supplement to the spare parts list until publication of a new edition.

Repair manuals and “Service / Technical Information” sheets should be available at the site where repairs are carried out.

It is not permitted to give them to third parties.

Use original ALTO spare parts only.

Safety instructions

For your own safety

Repair work should be carried out by persons instructed in electrical installations or by trained electricians only.

Observe valid safety regulations for electrical equipment.In particular, observe the following regulations:
IEC 60335-2-69
EN 60335 -2-69

Additionally:
Also see national regulations.

Before using the cleaner, always read the operating instructions and keep them readily available.

Only allow the high pressure cleaner to be used by persons who have been trained in its use and who have been explicitly authorized to use it.

ESD measures (electrostatic discharge)

Take the following ESD precautions before carrying out any repairs to the electronics:

• Touch the earth conductor before repairing the cleaner (to discharge electrostatic charge from your body).

• Wear wrist band if necessary.

• Use a conductive floor covering or a conductive table cover.

• Never touch the printed circuit board or electronic components (always hold at plastic).

• Transport electronic components in conductive packaging (e.g. ESD bag).

		NEPTUNE 5-25 / GB	NEPTUNE 5-27 / EU
Water volume Q_{max}	l/h	720	700
Water volume Q_{IEC}	l/h / l/min.	660 / 11	630 / 10,5
Pressure P1 (working pressure)	bar	90	110
Pressure P2 / Q2	bar / l/min.	25 / 6,7	25 / 6,7
Pressure Pmax. I	bar	200	200
Pressure P max. II	bar	32	32
Temperature t max. I / II	°C	80 / 140	80 / 140
Heating power	kW	62	62
Electrical data	V/Ph/Hz/kW	230-240/1/50/3	230-240/1/50/3,3
Current consumption	A	13	14,8
Fuse (slow blow)	A	16	16
International Protection Class		IP X5	IP X5
HP-Nozzle		NT 0530	NT 0450
Water inlet pressure	bar	10	10
Water inlet temperature	°C	40	40
Water volume heat exchanger	l	4,78	4,78
Fuel consumption dt=45K	kg/h	3,2	3,2
Oilpressure	bar	12	12
Flue gas temperature	°C	170	170
$C0_2$ content min.	%	12	12
Soot rating		0-1	0-1
Efficiency burner	%	>92	>92
Sound pressure 1m	dB(A)	71,8	71,8
Sound power LWA	dB(A)	86,9	86,9
Reactive force	N	25	26
Motor		1 ~	1 ~
RPM	1/min	1450	1450
Piston		Ceramic	Ceramic
Piston diameter	mm	18	18
Stroke	mm	9,8	9,8
Pump oil		SAE 15W40	SAE 15W40
Pump oil quantity	l	1	1
Weight	kg/h	175	175
L x W x H	mm	1150/702/987	1150/702/987

Table 1.1: Neptune 5-25 / 5-27

Neptune 5-42

		NEPTUNE 5-42 / NO, BE	NEPTUNE 5-42 / EU
Water volume Q_{max}	l/h	860	860
Water volume Q_{IEC}	l/h / l/min.	800 / 13,3	800 / 13,3
Pressure P1 (working pressure)	bar	170	170
Pressure P2 / Q2	bar / l/min.	25 / 6,7	25 / 6,7
Pressure Pmax. I	bar	250	250
Pressure P max. II	bar	32	32
Temperature t max. I / II	°C	80 / 140	80 / 140
Heating power	kW	80	80
Electrical data	V/Ph/Hz/kW	230-400/3/50/5,6	400-415/3/50/5,6
Current consumption	A	15,8	9,1
Fuse (slow blow)	A	20	16
International Protection Class		IP X5	IP X5
HP-Nozzle		NT 0450	NT 0450
Water inlet pressure	bar	10	10
Water inlet temperature	°C	40	40
Water volume heat exchanger	l	4,78	4,78
Fuel consumption dt=45K	kg/h	3,9	3,9
Oilpressure	bar	12	12
Flue gas temperature	°C	170	170
$C0_2$ content min.	%	12	12
Soot rating		0-1	0-1
Efficiency burner	%	>92	>92
Sound pressure 1m	dB(A)	73,8	73,8
Sound power LWA	dB(A)	88,8	88,8
Reactive force	N	42	42
Motor		3 ~	3 ~
RPM	1/min	1450	1450
Piston		Ceramic	Ceramic
Piston diameter	mm	18	18
Stroke	mm	12,8	12,8
Pump oil		SAE 15 W 40	SAE 15 W 40
Pump oil quantity	l	1	1
Weight	kg/h	180	180
L x W x H	mm	1150/702/987	1150/702/987

Table 1.2: Neptune 5-42

		NEPTUNE 5-49 / NO, BE	NEPTUNE 5-49 / EU
Water volume Q_{max}	l/h	970	970
Water volume Q_{IEC}	l/h / l/min.	900 / 15	900 / 15
Pressure P1 (working pressure)	bar	180	180
Pressure P2 / Q2	bar / l/min.	25 / 6,7	25 / 6,7
Pressure Pmax. I	bar	250	250
Pressure P max. II	bar	32	32
Temperature t max. I / II	°C	80 / 140	80 / 140
Heating power	kW	80	80
Electrical data	V/Ph/Hz/kW	230-400/3/50/6,9	400-415/3/50/6,9
Current consumption	A	21,7	12,5
Fuse (slow blow)	A	25	16
International Protection Class		IP X5	IP X5
HP-Nozzle		NT 0550	NT 0550
Water inlet pressure	bar	10	10
Water inlet temperature	°C	40	40
Water volume heat exchanger	l	4,78	4,78
Fuel consumption dt=45K	kg/h	4,3	4,3
Oilpressure	bar	12	12
Flue gas temperature	°C	170	170
$C0_2$ content min.	%	12	12
Soot rating		0-1	0-1
Efficiency burner	%	>92	>92
Sound pressure 1m	dB(A)	75,8	75,8
Sound power LWA	dB(A)	90,2	90,2
Reactive force	N	47	47
Motor		3 ~	3 ~
RPM	1/min	1450	1450
Piston		Ceramic	Ceramic
Piston diameter	mm	18	18
Stroke	mm	14,6	14,6
Pump oil		SAE 15 W 40	SAE 15 W 40
Pump oil quantity	l	1	1
Weight	kg/h	184	184
L x W x H	mm	1190/702/987	1190/702/987

Table 1.3: Neptune 5-49

Neptune 5-57

		NEPTUNE 5-57 / NO, BE	NEPTUNE 5-57 / EU
Water volume Q_{max}	l/h	1080	1080
Water volume Q_{IEC}	l/h / l/min.	1000 / 16,7	1000 / 16,7
Pressure P1 (working pressure)	bar	200	200
Pressure P2 / Q2	bar / l/min.	25 / 6,7	25 / 6,7
Pressure Pmax. I	bar	250	250
Pressure P max. II	bar	32	32
Temperature t max. I / II	°C	80 / 140	80 / 140
Heating power	kW	80	80
Electrical data	V/Ph/Hz/kW	230-400/3/50/7,9	400-415/3/50/7,9
Current consumption	A	24,8	14,3
Fuse (slow blow)	A	32	16
International Protection Class		IP X5	IP X5
HP-Nozzle		NT 0550	NT 0550
Water inlet pressure	bar	10	10
Water inlet temperature	°C	40	40
Water volume heat exchanger	l	4,78	4,78
Fuel consumption dt=45K	kg/h	4,8	4,8
Oilpressure	bar	12	12
Flue gas temperature	°C	170	170
$C0_2$ content min.	%	12	12
Soot rating		0-1	0-1
Efficiency burner	%	>92	>92
Sound pressure 1m	dB(A)	74,1	74,1
Sound power LWA	dB(A)	89,1	89,1
Reactive force	N	55	55
Motor		3 ~	3 ~
RPM	1/min	1450	1450
Piston		Ceramic	Ceramic
Piston diameter	mm	20	20
Stroke	mm	12,8	12,8
Pump oil		SAE 15 W 40	SAE 15 W 40
Pump oil quantity	l	1	1
Weight	kg/h	184	184
L x W x H	mm	1150/702/987	1150/702/987

Table 1.4: Neptune 5-57

Neptune 7-25

		NEPTUNE 7-25 / GB
Water volume Q_{max}	l/h	720
Water volume Q_{IEC}	l/h / l/min.	660 / 11
Pressure P1 (working pressure)	bar	90
Pressure P2 / Q2	bar / l/min.	25 / 6,7
Pressure Pmax. I	bar	200
Pressure P max. II	bar	32
Temperature t max. I / II	°C	80 / 140
Heating power	kW	80
Electrical data	V/Ph/Hz/kW	230-240/1/50/3
Current consumption	A	13
Fuse (slow blow)	A	13
International Protection Class		IP X5
HP-Nozzle		NT 0550
Water inlet pressure	bar	10
Water inlet temperature	°C	40
Water volume heat exchanger	l	4,78
Fuel consumption dt=45K	kg/h	3,2
Oilpressure	bar	12
Flue gas temperature	°C	170
$C0_2$ content min.	%	12
Soot rating		0-1
Efficiency burner	%	>92
Sound pressure 1m	dB(A)	72,5
Sound power LWA	dB(A)	87,6
Reactive force	N	25
Motor		1 ~
RPM	1/min	1450
Piston		Ceramic
Piston diameter	mm	24
Wobble disc		# 1
Pump oil		Alphasyn-T ISO 150
Pump oil quantity	l	1
Weight	kg/h	189
L x W x H	mm	1150/702/987

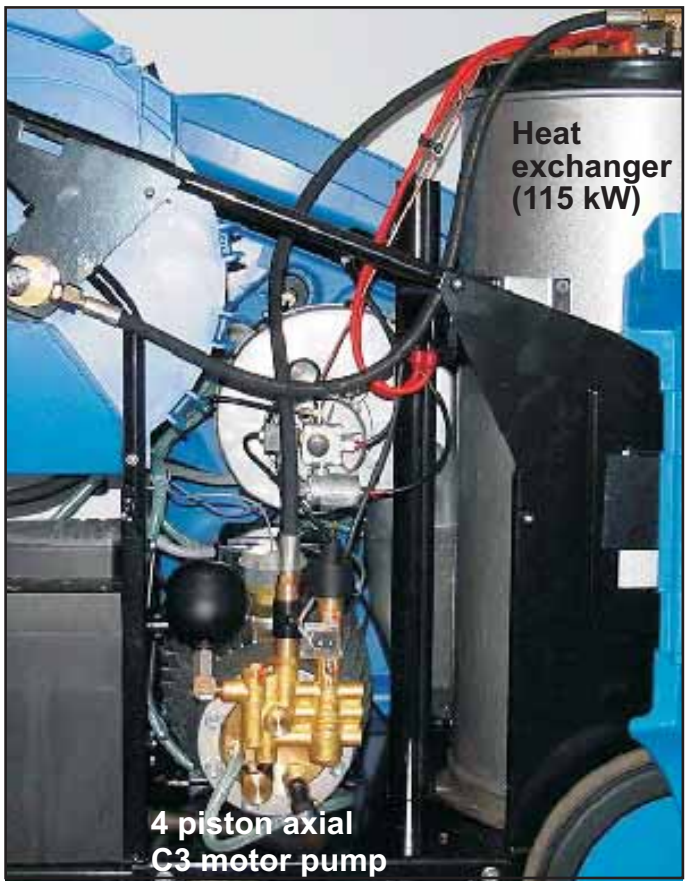
Table 1.5: Neptune 7-25

		NEPTUNE 7-63 / NO, BE	NEPTUNE 7-63 / EU
Water volume Q_{max}	l/h	1260	1260
Water volume Q_{IEC}	l/h / l/min.	1170 / 19,5	1170 / 19,5
Pressure P1 (working pressure)	bar	175	175
Pressure P2 / Q2	bar / l/min.	25 / 6,7	25 / 6,7
Pressure Pmax. I	bar	250	250
Pressure P max. II	bar	32	32
Temperature t max. I / II	°C	100/140	100/140
Heating power	kW	115	115
Electrical data	V/Ph/Hz/kW	230-400/3/50/8,3	400-415/3/50/8,3
Current consumption	A	23,4	13,5
Fuse (slow blow)	A	25	16
International Protection Class		IP X5	IP X5
HP-Nozzle		NT 0680	NT 0680
Water inlet pressure	bar	10	10
Water inlet temperature	°C	40	40
Water volume heat exchanger	l	6,12	6,12
Fuel consumption dt=45K	kg/h	5,6	5,6
Oilpressure	bar	12	12
Flue gas temperature	°C		
$C0_2$ content min.	%	12	12
Soot rating		0-1	0-1
Efficiency burner	%	>92	>92
Sound pressure 1m	dB(A)	76,6	76,6
Sound power LWA	dB(A)	91,7	91,7
Reactive force	N	61	61
Motor		3 ~	3 ~
RPM	1/min	1450	1450
Piston		Ceramic	Ceramic
Piston diameter	mm	24	24
Wobble disc		# 12	# 12
Pump oil		Alphasyn-T ISO 150	Alphasyn-T ISO 150
Pump oil quantity	l	1	1
Weight	kg/h	217	217
L x W x H	mm	1150/702/1020	1150/702/1020

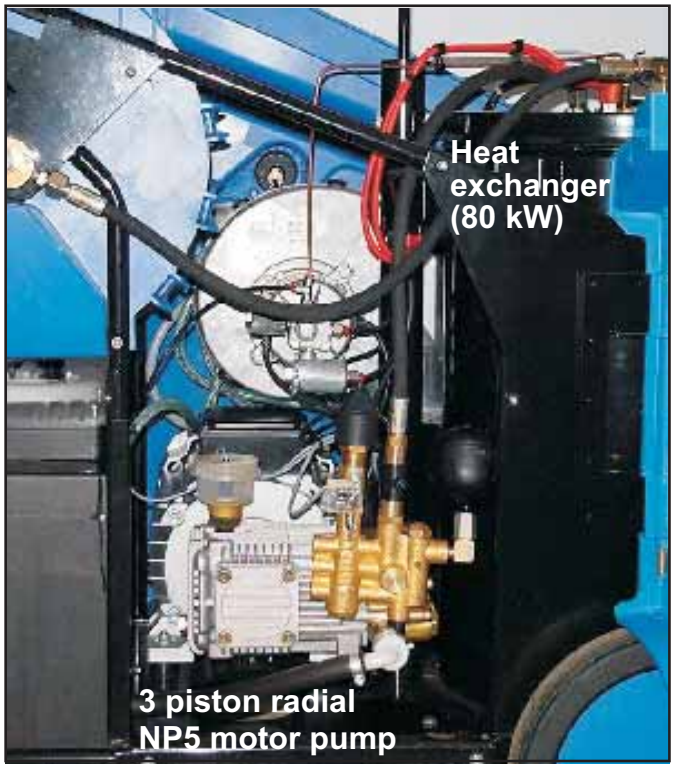
Table 1.6: Neptune 7-63

Neptune 5 / 7

In this manual two different models are described: the NEPTUNE 5 and the NEPTUNE 7. The two models are built with the same frame and cabinet.
Visually they are different on two points - the height of the heat exchanger and the type of motor pump used.



Pic. 3.1: Neptune 7 (C3 motor pump & heat exchanger)



Pic. 3.2: Neptune 5 (NP5 motor pump & heat exchanger)

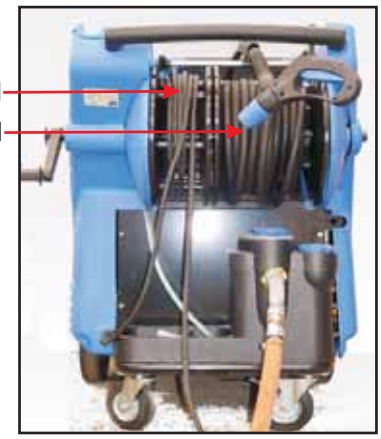
NEPTUNE 7 variants

1 phase: 7-25*
3 phase: 7-63*

NEPTUNE 5 variants

1 phase: 5-25* / 5-27*
3 phase: 5-42* / 5-49* / 5-57*

(*) These numbers refer to the theoretical total impact spraying water calculated by the formula:
Impact = 0.024 x (l / min at max pressure) x √ (nozzle pressure (bar) / 0.981)



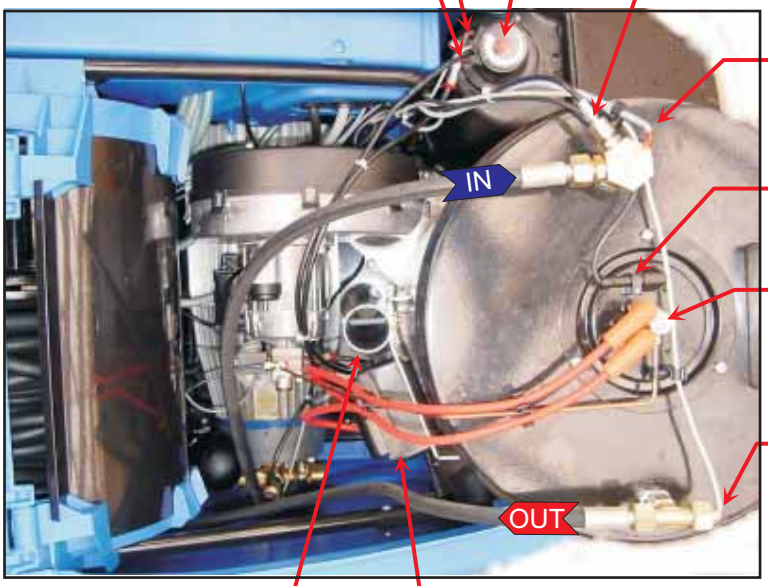
Pic. 3.3: Neptune X2-model

Extended versions:

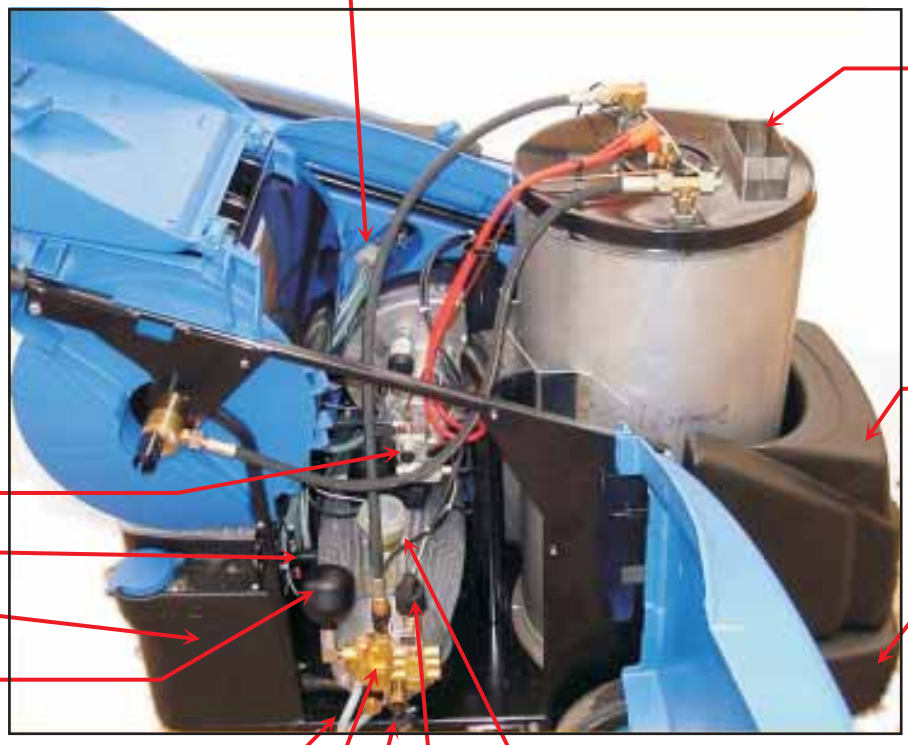
Standard models:	basket for accessories
X-models:	hose reel
X2-models:	hose reel & cable reel (Pic. 3.3)

Service side

With the service doors open there is free access to all technical parts that require service (Pic. 3.4 and Pic 3.5).



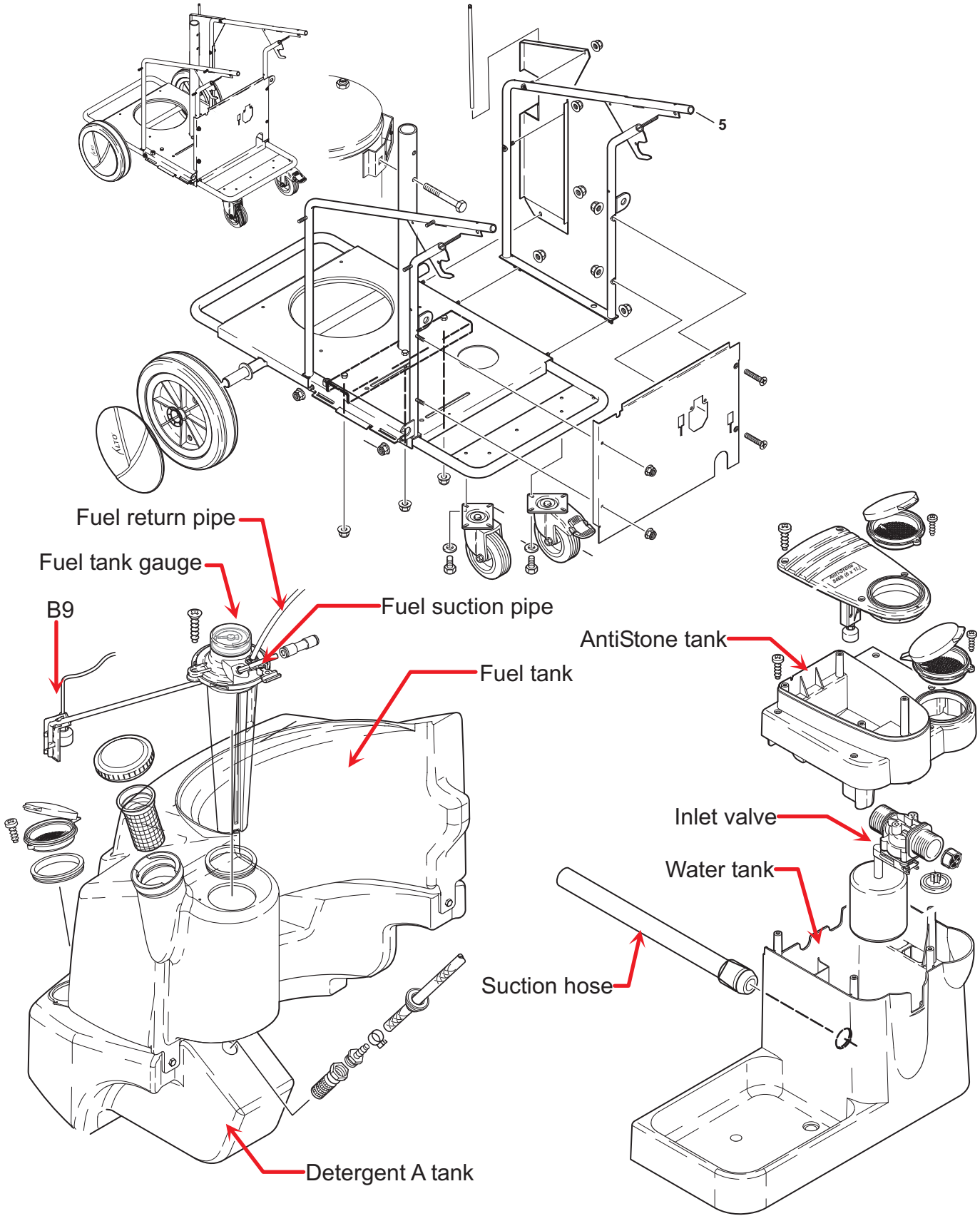
Pic. 3.4: Neptune top view



Pic. 3.5: Neptune side view

Frame 5 / 7

The frames of Neptune 5 and 7 are identical and built up in a straightforward form, all bolted together (see drawings).



Operator side

The electric box (Pic. 3.8) contains the control board, the transformer, relays, fuses and connection terminals. The cover plate is mounted with the main switch, the display, the temperature adjustment and five status / warning lights (Pic. 3.6).
The cover is sealed around the edge, the manometer and the detergent valve (Pic. 3.7).
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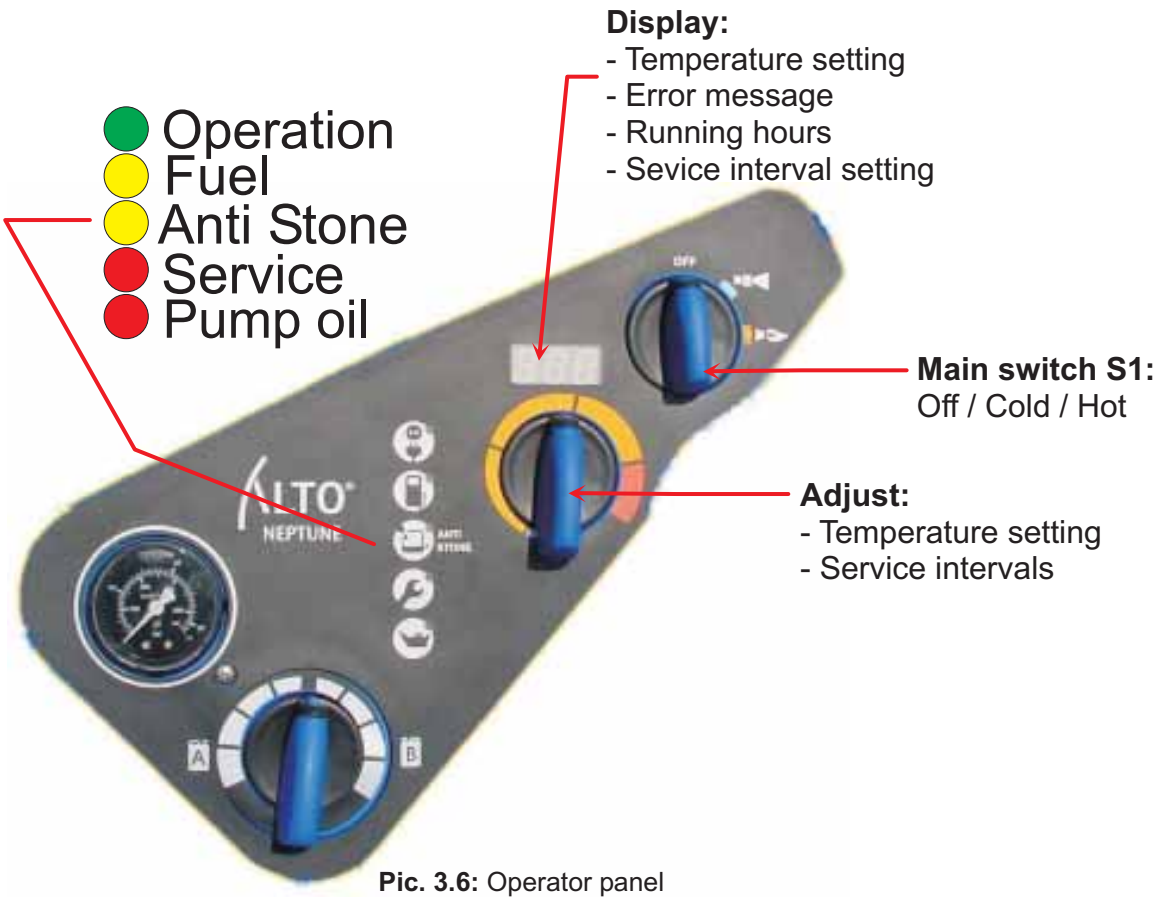
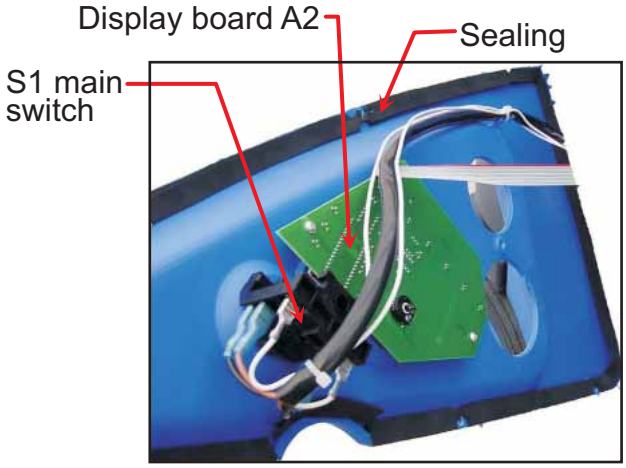
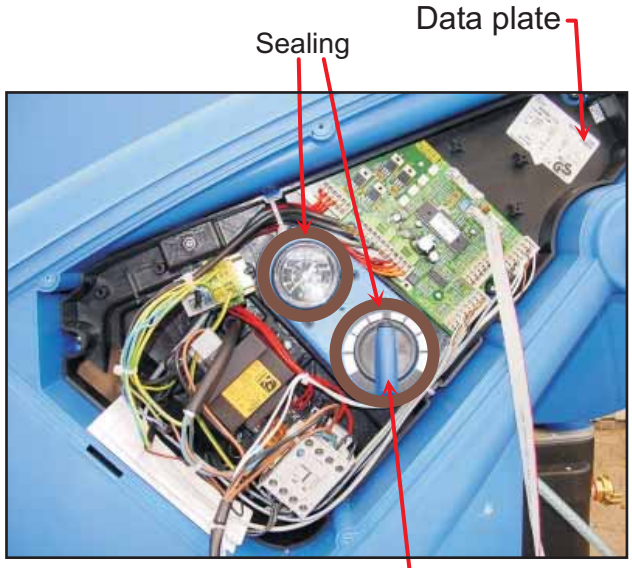


Pic. 3.6: Operator panel



Pic. 3.7: Operator panel (backside)

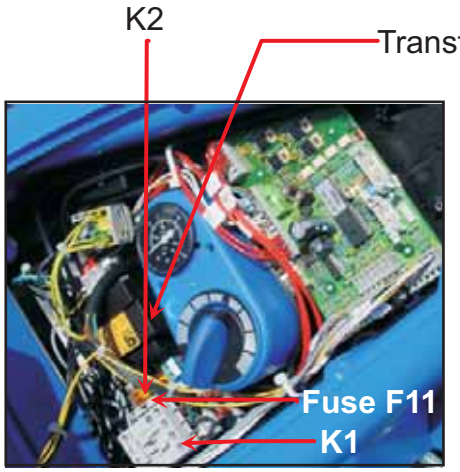


Pic. 3.8: Electrical box

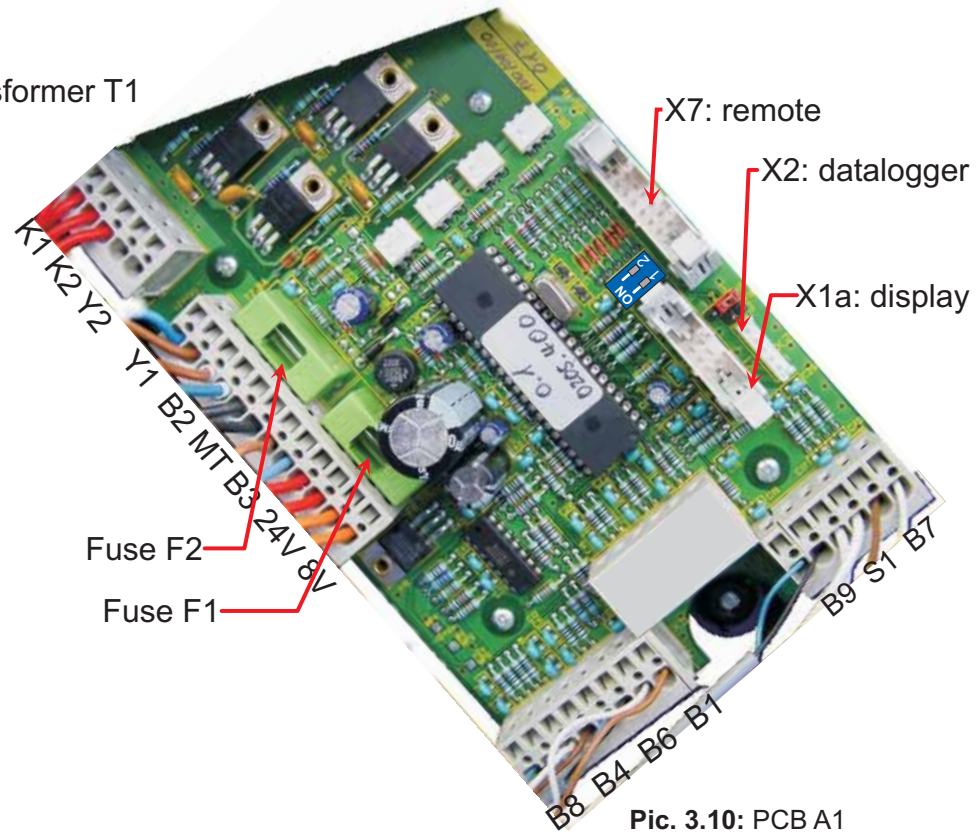
The cover is hinged in the lower left side and secured with a strap to avoid stress on the display connection cable.

Electric system

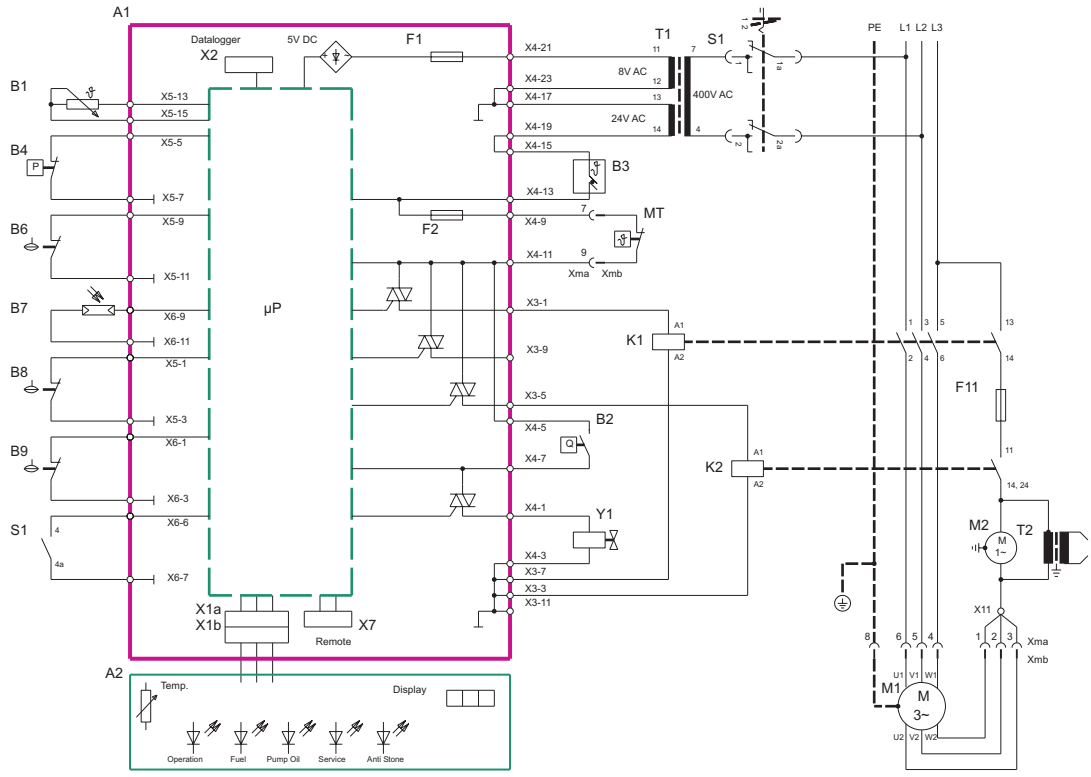
The electric control system is built up around the control board A1 (Pic. 3.10) which is divided into two systems, a 5 VDC system on one side to supply the sensors B8, B4, B6, B1, B9, B7 and on the other side 24 VAC, which supplies the actors (contactor, relay, solenoid valve).
The transformer T1 (Pic. 3.9) supplies the system with 24 VAC and 8 VAC.



Pic. 3.9: Electrical box



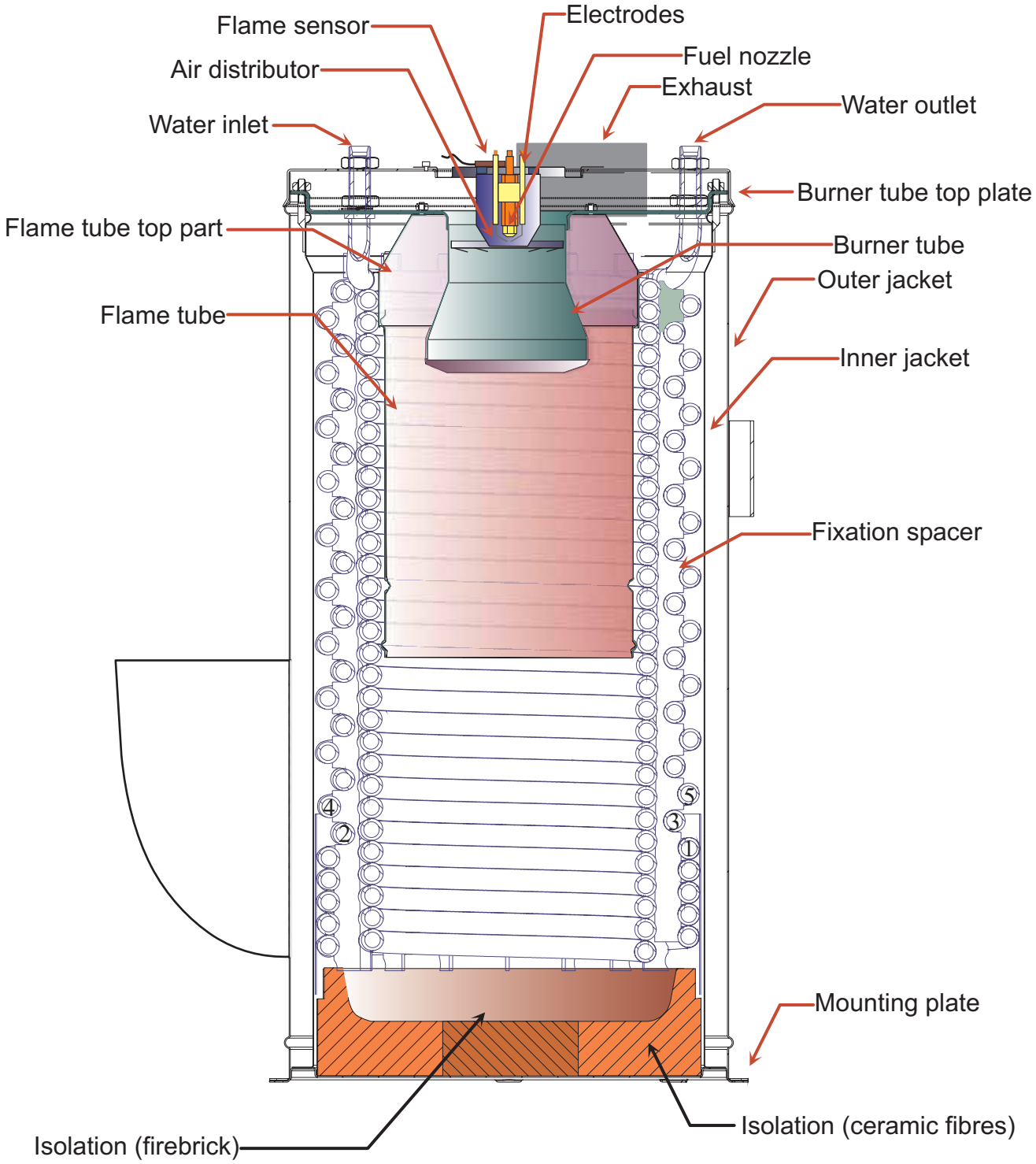
Pic. 3.10: PCB A1



More details about all sensors and the electrical system see page 22 / 23.

Heat exchanger

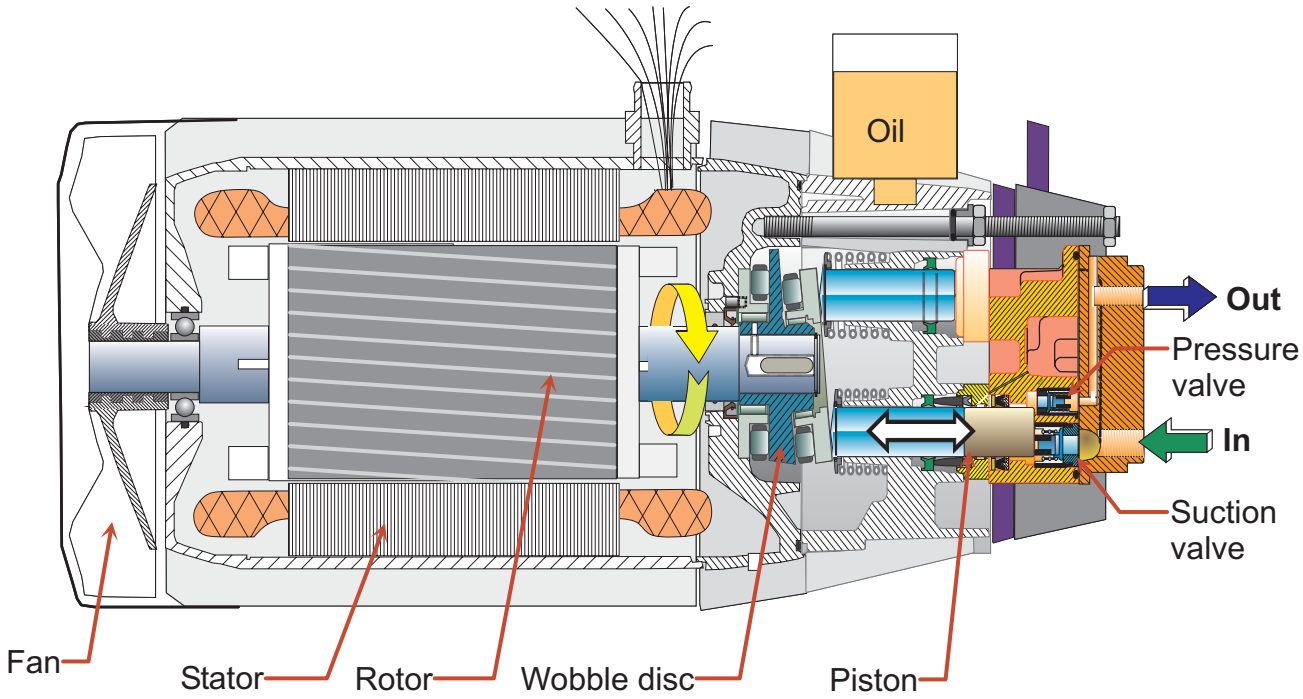
The heat exchanger is the heat generating part of a hot water machine. It consists of a labyrinth-constructed tube coil, which encloses the combustion chamber. The tube coil is enclosed by a double container with boiler jacket, bottom and top in a sandwich construction, between which the pre-heated air is routed into the combustion chamber. An insulating material placed in the bottom of the heat exchanger makes sure that the inner bottom, among other things, is protected from superheating.



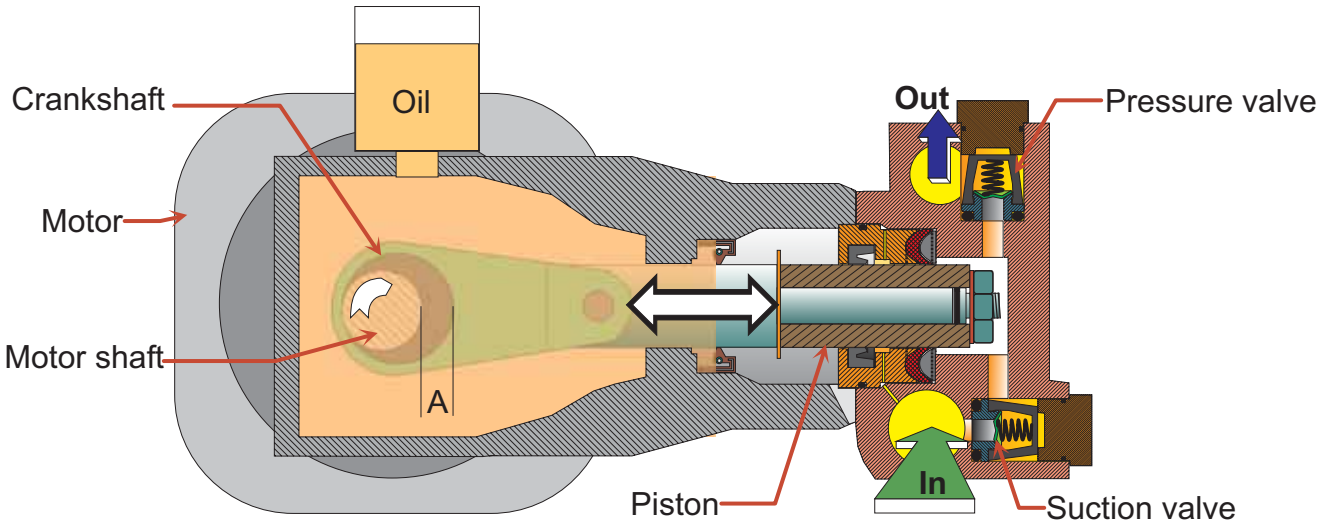
Note the heat exchanger tube arrangement in the the outer circle where the tube change position on its way up (1 - 2 - 3 - 4 - 5) to equalize the water temperature.

Pump 7 / 5

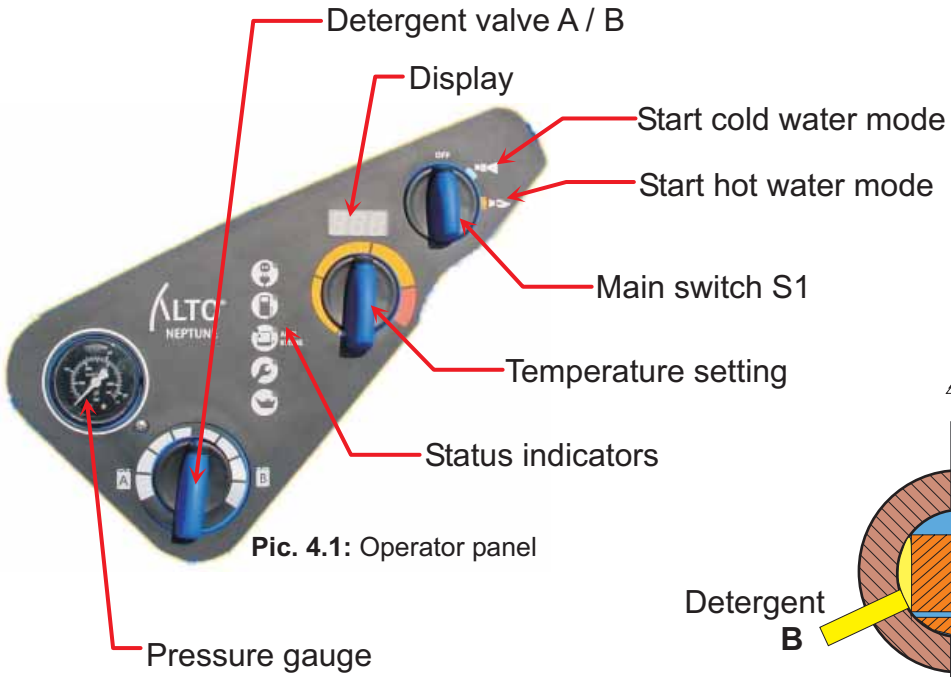
The four piston axial pump C3 used in the Neptune 7 models is a compact unit with motor and pump built together in line (axial).



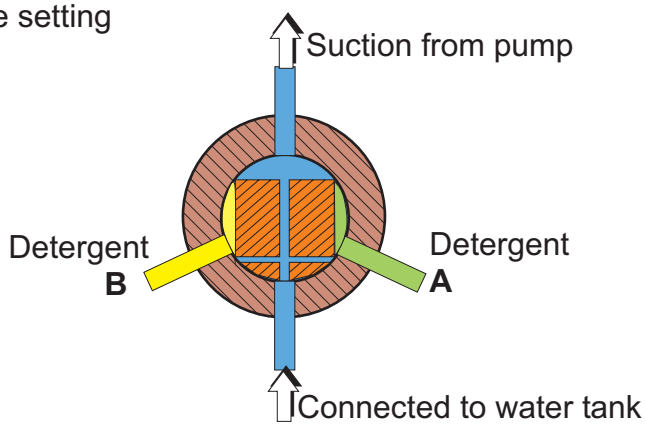
The three piston radial pump NP5 used in the Neptune 5 models is a compact unit with motor and pump.



Operation



Pic. 4.1: Operator panel



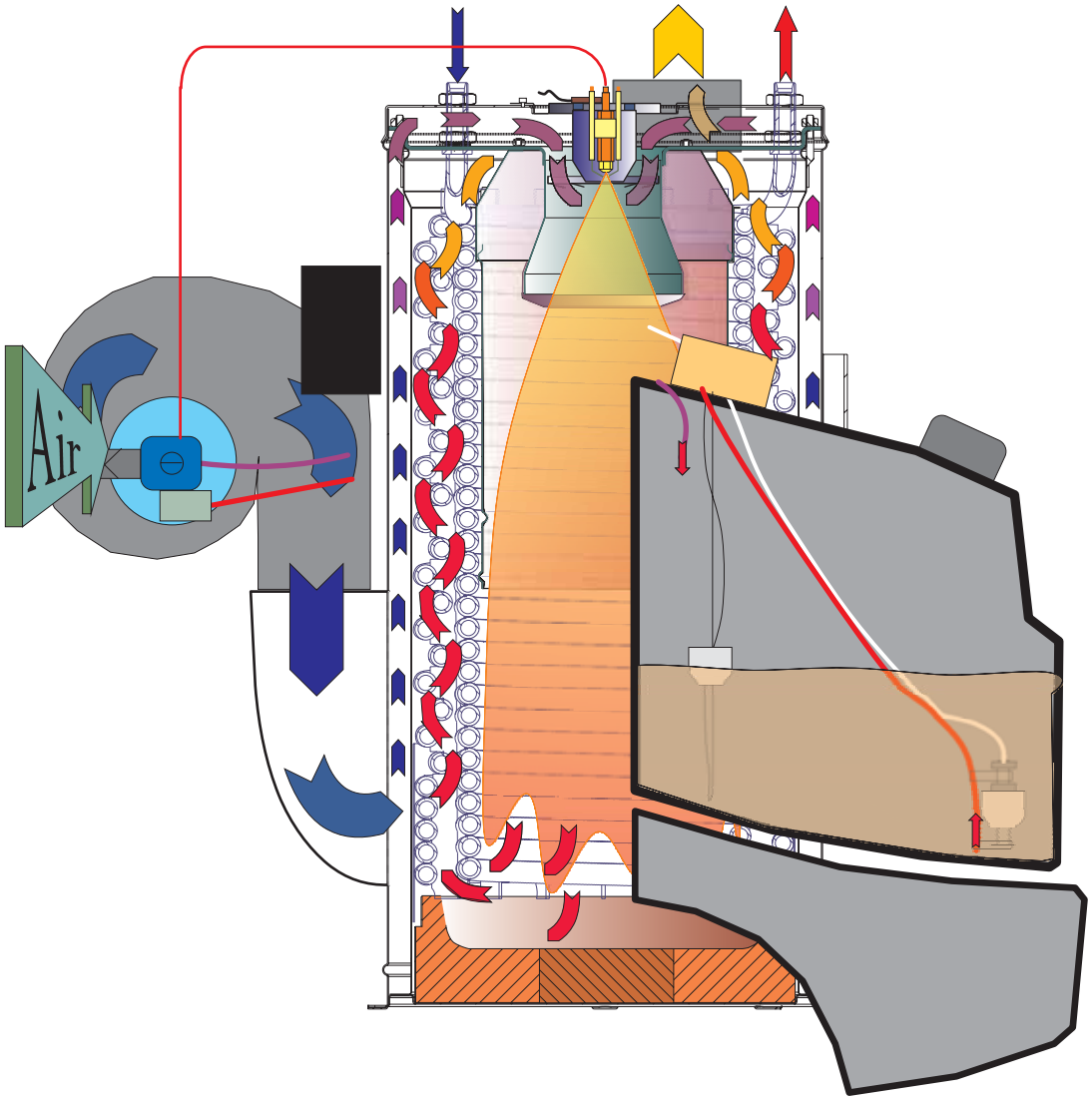
<u>If the machine and power supply are o.k. (depending on the electronic set-up) following will happen doing start up:</u>

When the main switch S1 is turned on to cold or hot water mode, the machine runs a self test (3 dashes are shown in the display). Optionally it's possible to show the actual running hours of the pump for 5 seconds by setting a jumper on X9 on PCB A1 before the self test.
Afterwards the motor will start building up pressure until cut off pressure and then by-pass for 20 s before it stops. After the self test procedure the display shows the temperature setpoint °C or °F (depending on dip switch setting on PCB A1).
The status indicator lights up the green light on the plug icon only and the pressure gauge shows max. pressure.
Now the machine is on stand-by in cold water mode.
By switching to hot water mode the machine remains in stand-by mode.
When the spray handle is activated, the pump will deliver water. At the same time the fan for the burner starts ventilating the combustion chamber for 3 s before fuel is pumped into the heat exchanger and the combustion starts.
The water temperature will now raise until the setpoint has been reached. The combustion stops, when the actual temp. value exceeds the setpoint, but the fan and ignition are still working. When the temperture falls short of the setpoint combustion kicks-off again.

The detergent valve makes it possible to choose between detergent A from the built in tank or detergent B from a canister. With the valve in off position as shown it draws in water from the water break tank to clean the valve and the hose to the pump.

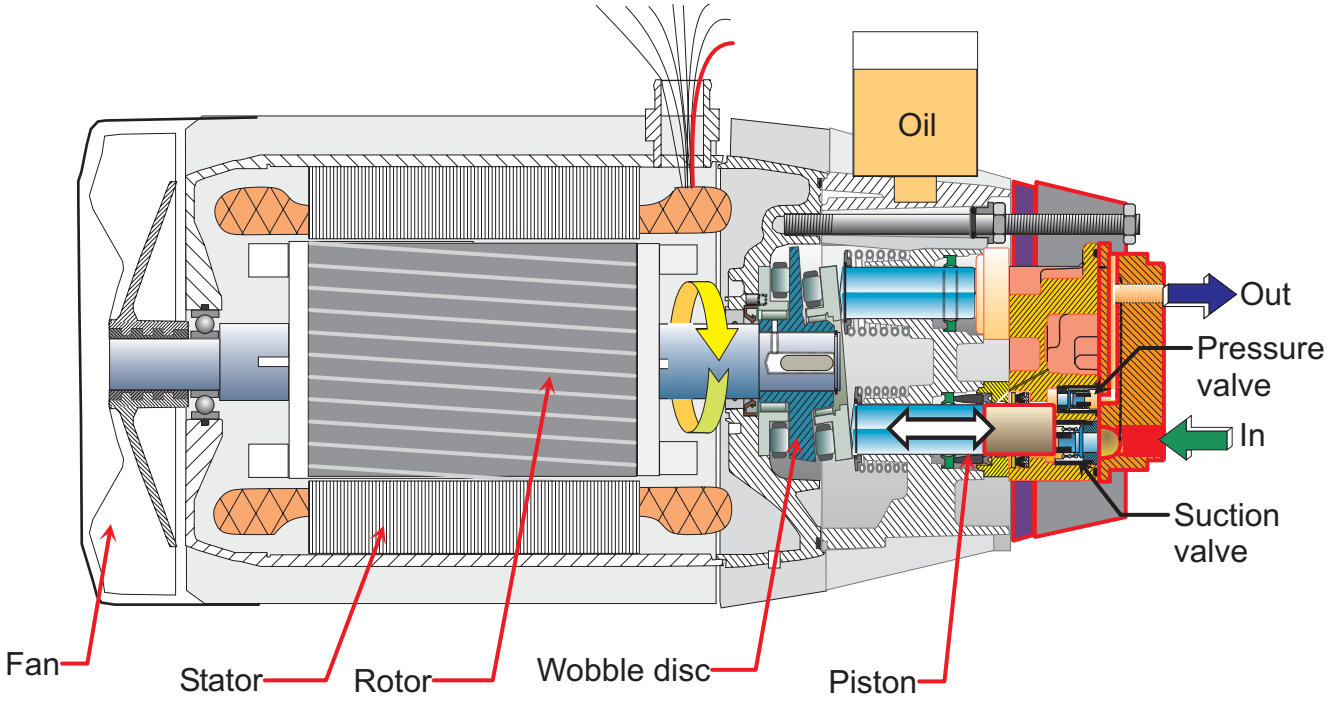
Heat exchanger

When the machine is running in hot water mode the fan draws in air and leads it into the side of the heat exchanger around and between the two jackets up to the air distributor. On the way, the air is preheated before it is mixed with the oil spray from the nozzle.
The cold water enters the boiler at the inner winding where the temperature is highest. By doing so, it will minimize the condensation of water on the surface of the tube.



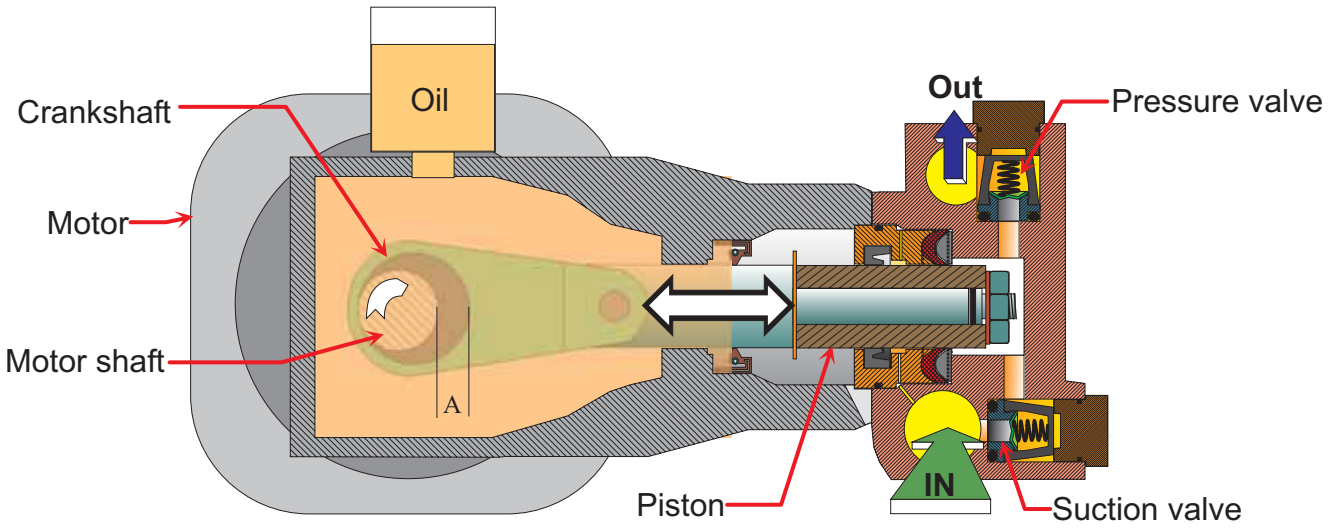
In hot water mode fuel is drawn from the tank through the fuel filter to the pump. If combustion is required, fuel passes through the magnetic solenoid valve to the nozzle in the air distributor. Fuel is returned to the tank if combustion is not required.
The ignition transformer is active in hot water mode and it will form sparks between the electrodes. If the flame is not developed when it should be, a flame sensor placed on top of the boiler will secure that the fuel pump is automatically stopped and a fault code will be shown on the display.
When the machine and heat exchanger are operating properly the flame touches against the insulated bottom. The temperature is here approximately 1100°C. The hot exhaust gas is forced further round the labyrinth-shaped combustion chamber, where the heat is absorbed by the water in the tubes.

The C3 four piston axial pump used in the NEPTUNE 7 models



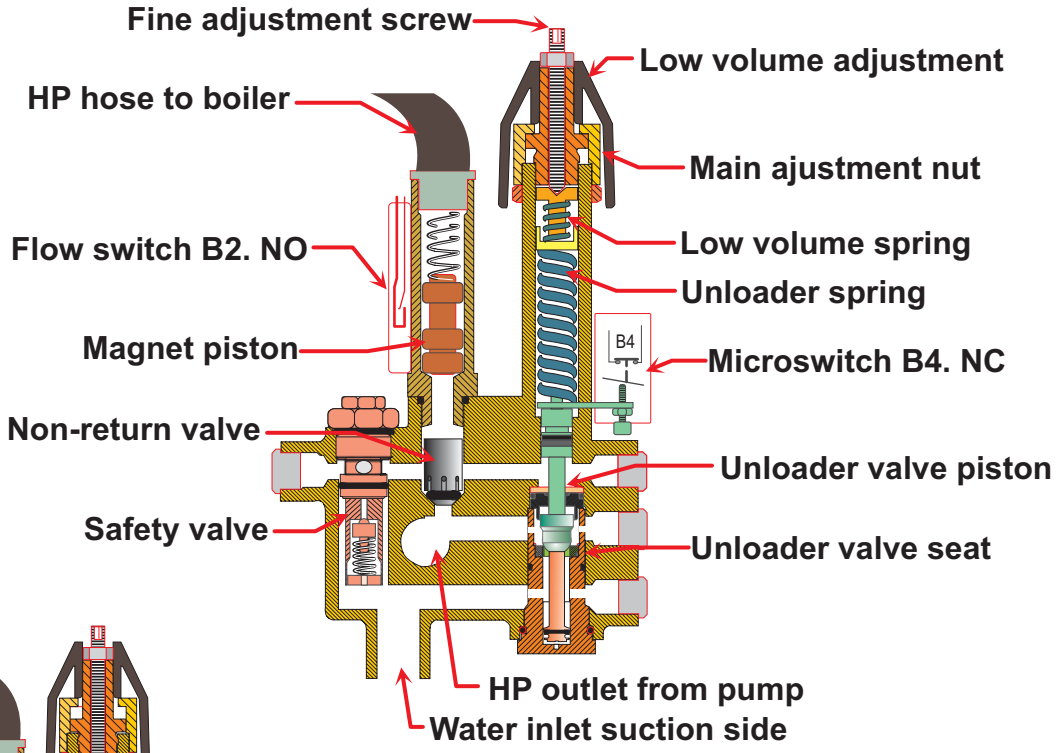
The four ceramic pistons are driven by a wobble disc which transforms the rotating power from the rotor into the reciprocating pump pistons. The angle of the disc and the diameter of the pistons decide the volume of water sucked through the suction valves and pressed out through the pressure valves.
The inlet and the outlet are connected directly to the Control Safety Block.

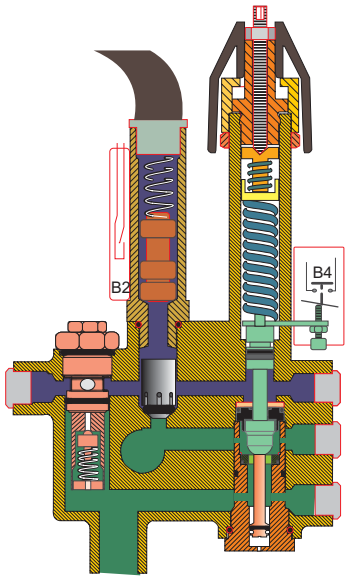
The NP5 three piston radial pump used in the Neptune 5 models



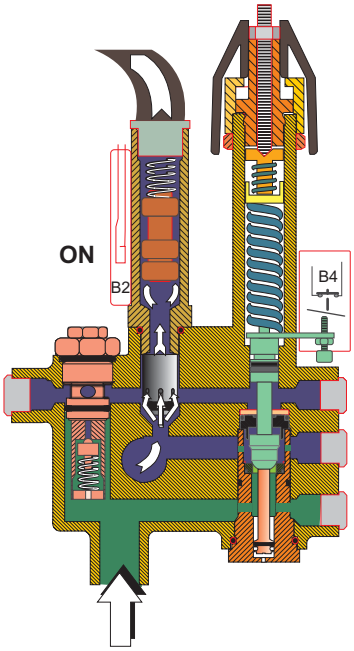
Three pistons are driven by connecting rods which are attached to a crankshaft which is, in turn, driven by the electric motor. The eccentricity of the crank (A) and the diameter of the pistons decide the volume of water sucked into the suction valves and pressed out through the pressure valves.
The inlet and the outlet are connected directly to the Control Safety Block.

Control Safety Block 1





When the machine is started with a closed spray gun:
The pressure rises until the cutoff pressure is reached (set by the unloader spring). The unloader valve piston is forced upwards and will open the microswitch B4, which signals the PCB A1 to start the timer which will stop the machine in 20 s. During that 20 s, the water being pumped will flow through the unloader valve seat and return to the pump. Also during the initial start, water is pressurized in the heat exchanger, the high pressure hose, and the HP chamber under the unloader valve piston. When the unloader valve opens, there is a lower pressure in the green area, and the non-return valve is forced onto its seat, trapping high pressure in the heat exchanger and HP hose. When the pump stops, pressure in the green area goes to 0 bar. High pressure is shown with blue in this drawing and low or no pressure, with green.



When the spray gun trigger is squeezed, the pressure trapped in the heat exchanger and HP hose is reduced and the unloader spring forces the piston down, allowing the microswitch B4 to close, which signals the PCB A1 to start the pump motor.
You can also see in this drawing that the magnet piston has moved up with water flow and will signal the PCB A1 to turn on the burner if hot water is selected.
The safety valve will only open if the pressure in the system exceeds P_{max} + 10 %, such as might be caused by a blocked unloader valve.

There are four purposes of the Control Safety Block:

1. To secure the machine against an excess of pressure.
2. To ensure a quick start.
3. To reduce the pressure in the pump when in by-pass mode.
4. Allow regulation of water volume.

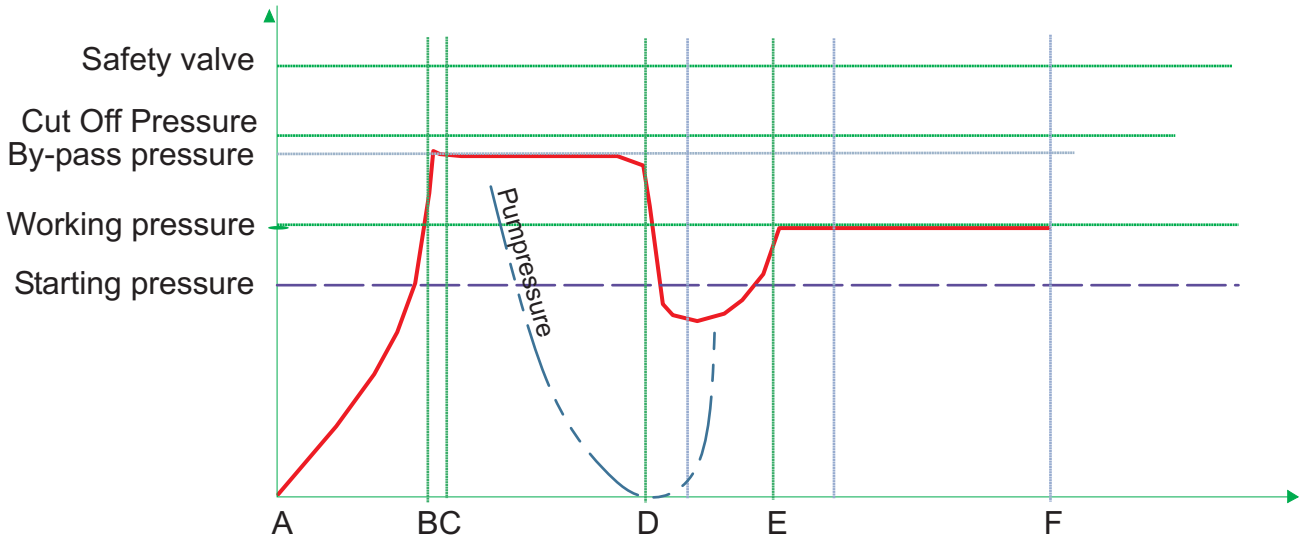


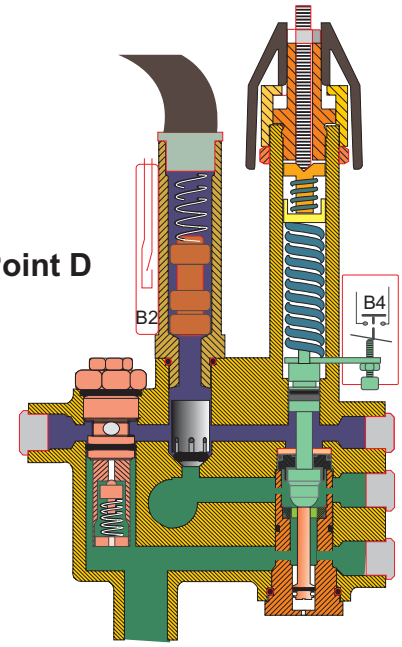
Diagram 4.1: Pressure development Neptune 7-63

Mounted with an 0680 nozzle and connected to a hose of 10 m the machine is started with inactivated spray gun.

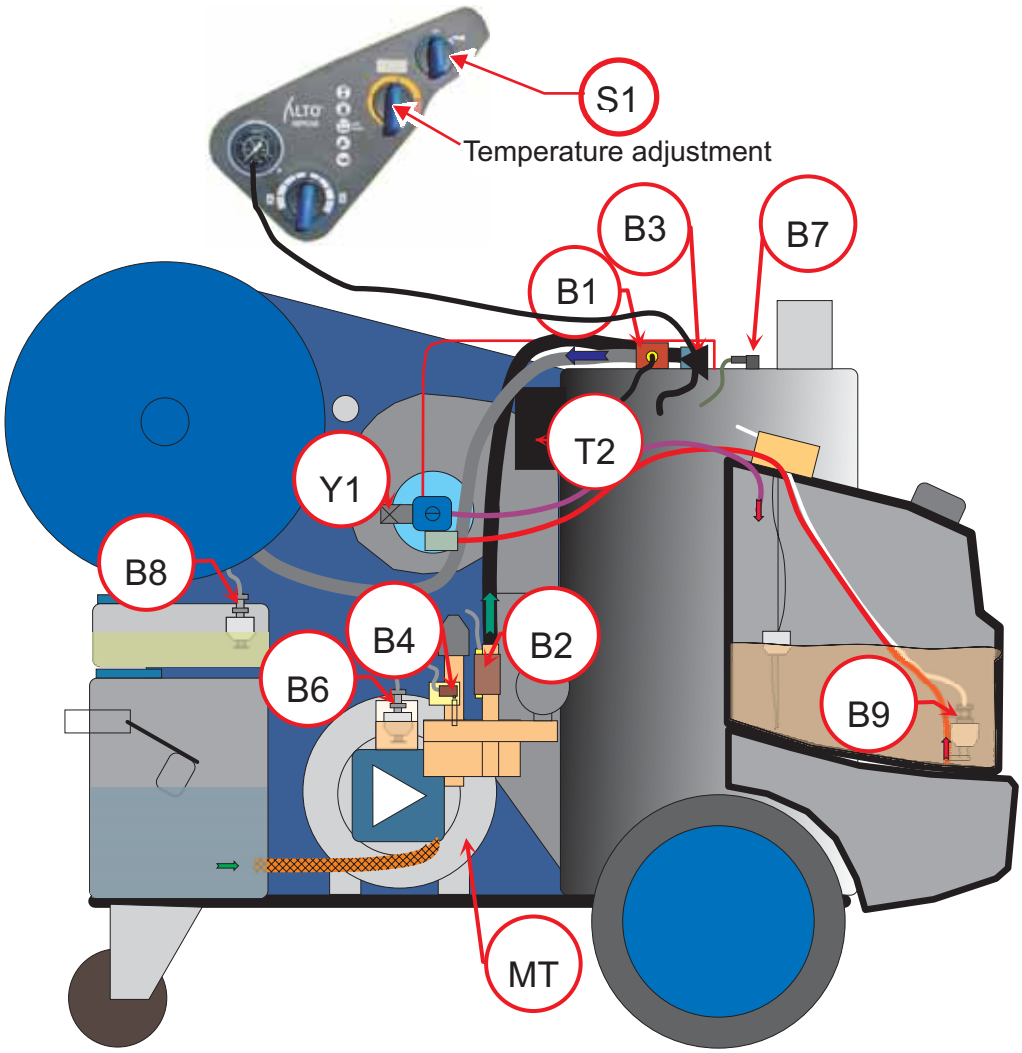
A: The pressure is building up until the unloader valve opens and the microswitch B4 activates the timer (**B**). The pressure will rise a little more but will drop immediately (**C**). After 20 s in by-pass, the motor stops (**D**). If the system is tight the pressure will remain. At the same time the pressure in the pump drops to zero (**D** - the dashed line).

D: The spray handle is activated and the pressure drops. The microswitch B4 closes and starts the motor. The pressure drops a little more, but will build up until the working pressure (approximately 165 bar in this example) is reached (**E**). As long as the spray handle is activated and the nozzle is unchanged the pressure is steady.

Point D



Sensors / Actors



Sensors:

B1: Temperature sensor at the outlet of the heat exchanger. Controls the combustion (Y1 on/off) according to setting.

B2: Flow switch senses the flow out of the pump into the heat exchanger and with B1, controls solenoid Y1 (on/off).

B3: Safety thermal switch placed at the inlet to the heat exchanger. Switches off the machine, if temperature becomes > 106 °C (222 °F). Will switch off, if the burner keeps burning without water flow through the heat exchanger - **"Can not be reset, but must be replaced after correcting the fault!"**

B4: NC Microswitch controls the motor start/stop. When pressure is higher than working pressure the switch will open and the motor stops.

B6: Oil level-sensor stops the machine if the pump is low on oil. Activates red light on panel.

B7: Flame-sensor detects light of the flame. If the flame is not detected when it should be, the machine will be stopped.

B8: Level switch AntiStone liquid. If low, yellow light will light up.

B9: Level switch fuel (stops the fuel valve) when low on fuel and yellow light appears on the panel.

MT: Temperature switch stops the motor if the temperature in the windings becomes > 160° C (320 °F). Automatic reset of MT.

S1: Main switch. Functions: on/off - cold water mode - hot water mode.

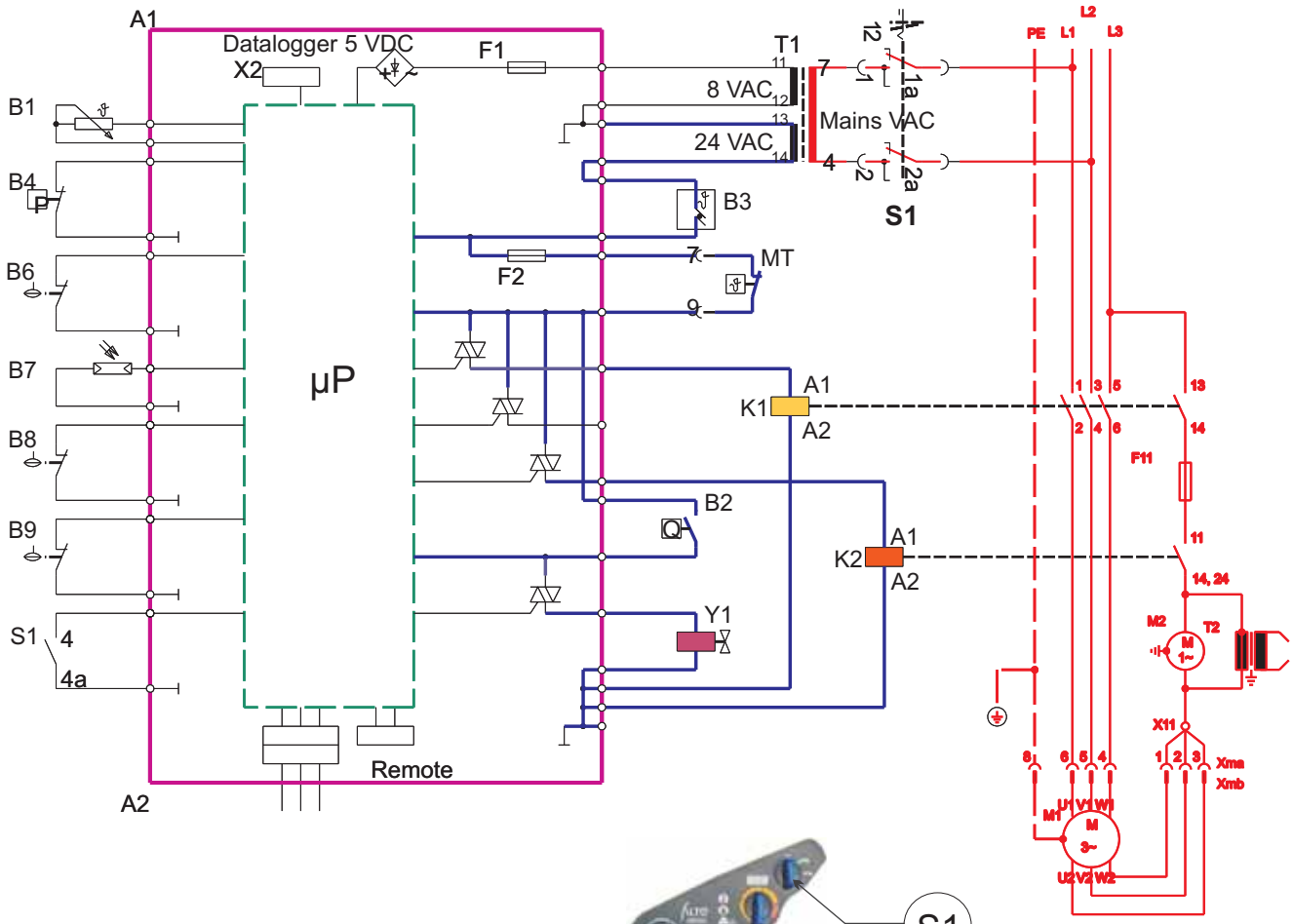
Actors:

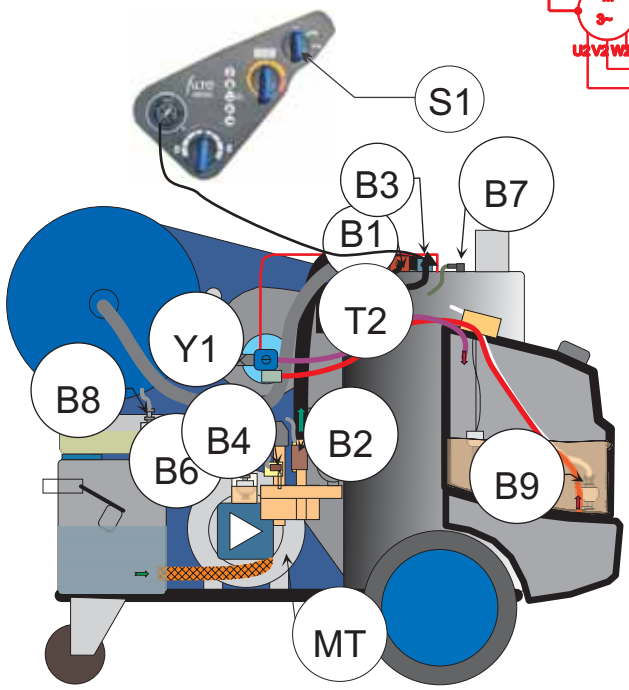
T2: Ignition transformer is on when burner fan is running.

Y1: Solenoid opens/closes the fuel for the burner.

Electric system

The machine is supplied with main power which is transformed into 8 VAC to supply the microprocessor and sensors and 24 VAC to supply the actors (contactor, relay, solenoid valve).
To run the machine on hot water the following must be o.k.: on the front panel S1 and the temperature setting on hot and the spray handle open. If all the sensors are closed and o.k. K1 will start the motor and K2 the ignition and fan. Y1 will open and let in fuel to the combustion chamber. If the flow stops B2 will open and the 24 VAC supply to the solenoid Y1 will be interrupted and the combustion will stop.





B1: Temperature sensor
B2: Flow switch
B3: Safety thermal switch
B4: Microswitch
B6: Oil level switch
B7: Flame sensor
B8: AntiStone level switch
B9: Fuel level switch
MT: Motor temp. switch
S1: Main switch
T2: Ignition transformer
Y1: Solenoid valve

Functional requirements

1. Water supply must be able to deliver the needed water at a min. of 1bar pressure.

2. The water inlet temperature must not exceed 40 °C (104 °F).

3. The water must be without impurities as for instance floating sands > (50 µ).

4. If the ambient temperature exceeds 40 °C when running constant (the motor thermal protection switch may open and stop the motor).

5. Variation in the mains voltage supply must be within 7% of the rated value at the machine (long or undersized extension cords can be a problem).

6. Diesel fuel must be of a standard as used on diesel engines. Kerosene can be used only in machines with a special fuel pump (e.g. all US variants will have it).

7. Exhaust gas must be led directly into the open air without restriction.

If these requirements are met and you still experience operational break-downs, there are faults on the system.

Check list

When trouble-shooting it will be a great help if you can locate the fault as being either an external fault or an internal fault

.

External faults are due to either improper maintenance, incorrect operation or operation under particularly straining conditions.

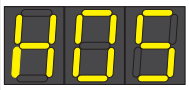
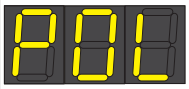
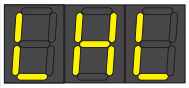
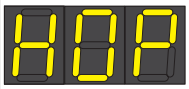
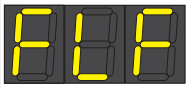
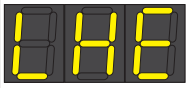
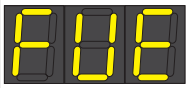
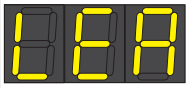
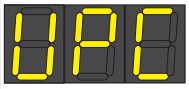
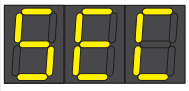
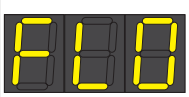
External faults usually represent the following:

The below-mentioned conditions have been checked and found ok:

	Yes	No	Comments
1. Installation fuse blown.	☐	☐	
2. Plug defective.	☐	☐	
3. Cable cracked or split	☐	☐	
4. Too long, too small or defective extension cables.	☐	☐	
5. High/low pressure nozzle blocked or worn.	☐	☐	
6. Spray handle defective or leaky.	☐	☐	
7. High pressure hose too long or defective.	☐	☐	
8. Water inlet filter (2) blocked (dirty water).	☐	☐	
9. Inadequate water supply.	☐	☐	
10. Air sucked into the pump (empty detergent tank selected).	☐	☐	
11. Detergent system blocked (dried-up).	☐	☐	
12. Inlet water too hot.	☐	☐	
13. Fuel filter blocked.	☐	☐	
14. Air adjustment faulty.	☐	☐	
15. Fuel level low or water in fuel tank.	☐	☐	

The **internal faults** require a systematic inspection of the motor pump by an ALTO technician. In order to establish the reason of the fault with certainty, it may be a help to use the yes / no-diagram or the flowchart on page 29.

Error codes

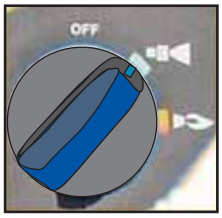
Display	Symptom	Cause		
		Outer	Inner	Check
	**Ho**t **S**afety temperature switch B3 opens when temp. is higher than 106 °C (222 °F).	Wire defective Use of long hoses at steam with leaky valves.	Flow and pressure switch out of adjustment. Oil residue in heat exchanger.	Heat exchanger security adjustment. Switch B3 must be changed if open.
	**P**ump **O**il **L**ow Switch B6 open	Wire defective.	Oil seals worn out	B6 switch
	**Lig**ht sensor B7 sees **L**ight, when Y1 is not activated Flame sensor short circuit (Cold water operation, not possible)	Sensor not in place. Wire defective.	Oil residue in heat exchanger is burning. Y1 Leaky. Ignition failure.	Oil pressure. Nozzle Electrode Flame sensor
	**Ho**t **M**otor **P**rotector Motor winding > 160 °C(320 °F)	Pump pressure too high. Temp in room > 40 °C (104 °F)	Fan on motor defective. Fuse (F1)	Sensor in windings.
	**Fl**ow **F**ailure Flow switch B2 closed and B4 open.	Wire defective	Flow piston hanging	Reed switch.
	No **Lig**ht, Fuel **E**nabled. Light sensor B7 sees no flame when Y1 is open.	Wire defective. Spark failure. Oil filter blocked soot on glass	Flow switch off.	Fuse (F11). Sensor B7.
	**Fu**el **E**mpty. Level switch B9 Open.	Wire defective		
	**Lea**kage. Three times start without flow.	Leaky system.	Leaky non-return valve.	B4 switch
	Micro**pro**c**c**essor failure.	Water in electric system		
	Temperature **Se**nsor (B1) **O**pen.	Wire defective.		
	Temperature **Se**nsor (B1) **C**losed	Wire defective.		
	**Fl**ow switch open (B2) and microswitch (B4) close.	Air in suction water. No water.		Detergent valve.

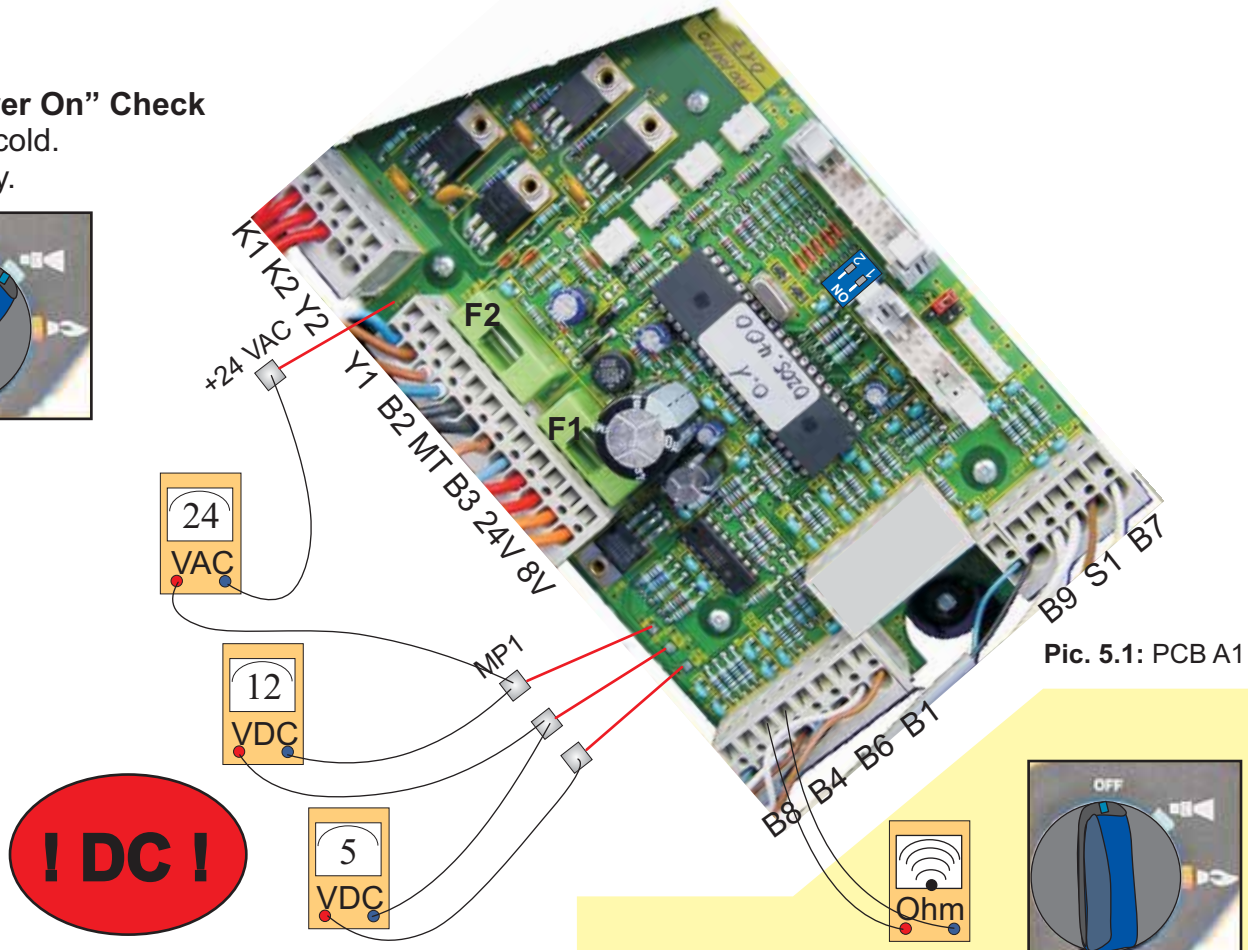
Electrical tests

Before you change the control board run through these tests:

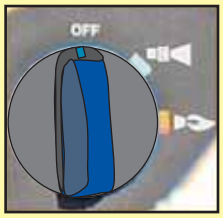
1. "Power On" Check

Turn to cold.
Stand-by.

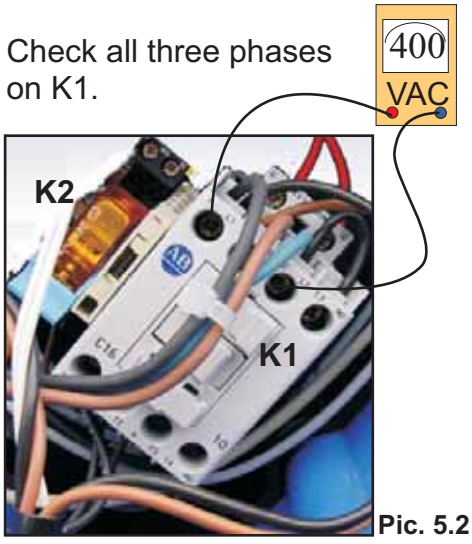




Pic. 5.1: PCB A1



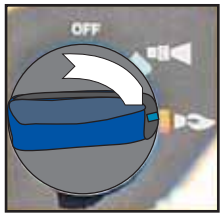
Check all three phases on K1.



Pic. 5.2: K1 & K2

2. K2 Check

Start relay to power up the burner.
Stop the Machine.



Turn switch to start and further to hot mode. Check visually that the relay K2 is switching on.
NB: this test must be carried out within the time (20 s) the machine is running in by-pass.

3. "Power Off" Check

Disconnect machine from mains power.
With Ohm meter in 'sound mode'.
Power off. Pressure O.

	O.k. if	If not o.k. check,
K1	X	Connection to coil A1-A2
K2	-	Go to power 'On Check'
Y1	X	Coil on fuel pump
B2	o	Flow switch position
MT	X	Connections in motor plug
B3	X	Change sensor B3
24 V	X	Transformer
8V	X	Transformer
B8	X	Level switch anti scale
B4	X	Micro switch setting
B6	X	Level switch oil
B1	X	Temperature sensor
B9	X	Level switch in fuel tank
S1	o	Go to power 'On Check'
B7	o	Wire and flame sensor

Heat exchanger performance

The symptom is reduced performance of the pump effect or the heat exchanger effect. The symptom of reduced heat exchanger effect is a lower water outlet temperature than the set value. The possible causes for this are as follows:

Scale deposits in heat exchanger tube

Scale formation acts as insulation and reduces heat transfer to the water. The result is raised flue gas temperature = increased flue gas loss.

Cause: The hardness of the water, no AntiStone or AntiStone dosing too low.
Remedy: Descale heat exchanger tube.

Sooted heat exchanger tube

Soot has the same effect as scale deposits, i.e. that they are both insulating against the heat transfer to the water and results in increased flue gas temperature = increased flue gas loss. Other symptoms are that the machine smokes after it is warmed up, during steady operation.

Cause 1: Air deficiency.
Remedy: Check air adjustment and fan attachment to heat exchanger.

Cause 2: Bad fuel / air mixture.
Remedy: Check fuel pressure and quality. Replace the fuel nozzle. Adjust air diffuser.

Cause 3: Unfinished combustion.
Remedy: Check bottom insulation, boiler top gasket between tube and inner heat exchanger jacket in top cover. Check burner tube.

Cause 4: Unstable ignition.
Remedy: Check electrodes. Adjust the air quantity (less air).

Cause 5: Leaky solenoid valve on pump Y1.
Remedy: Check / replace solenoid valve Y1.

Low fuel pressure

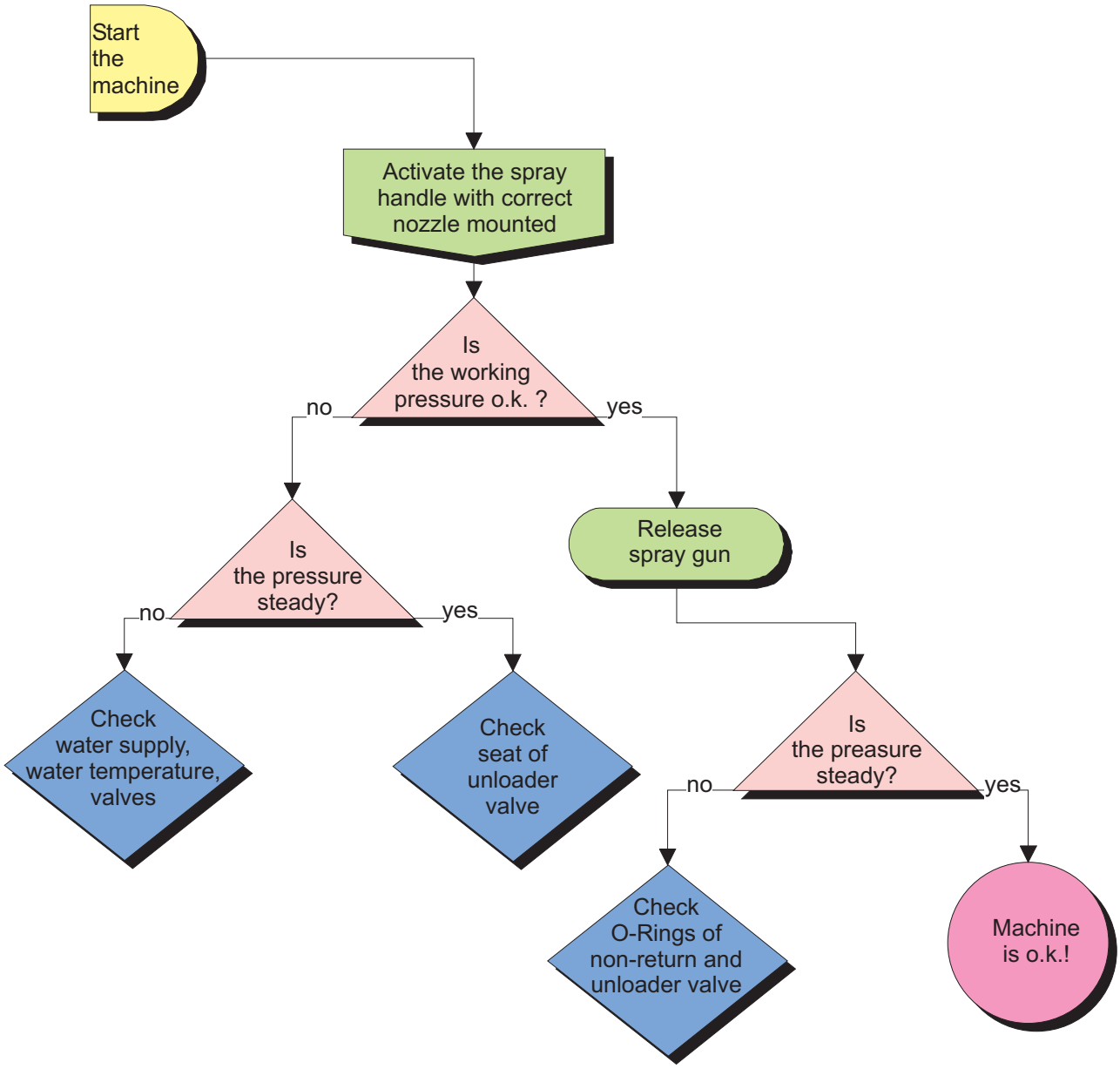
Cause 1: Incorrect adjustment.
Remedy: Adjust pump pressure (12 bar, see page 50).

Cause 2: Filter blocked, defective pump.
Remedy: Replace filter / pump. Empty and clean tank.

Full water volume at steam stage

Cause: Mechanical defect of by-pass valve or adjustment.
Remedy: Check by-pass valve.

Pressure



The pressure of the machine drops, the machine vibrates and makes a noise

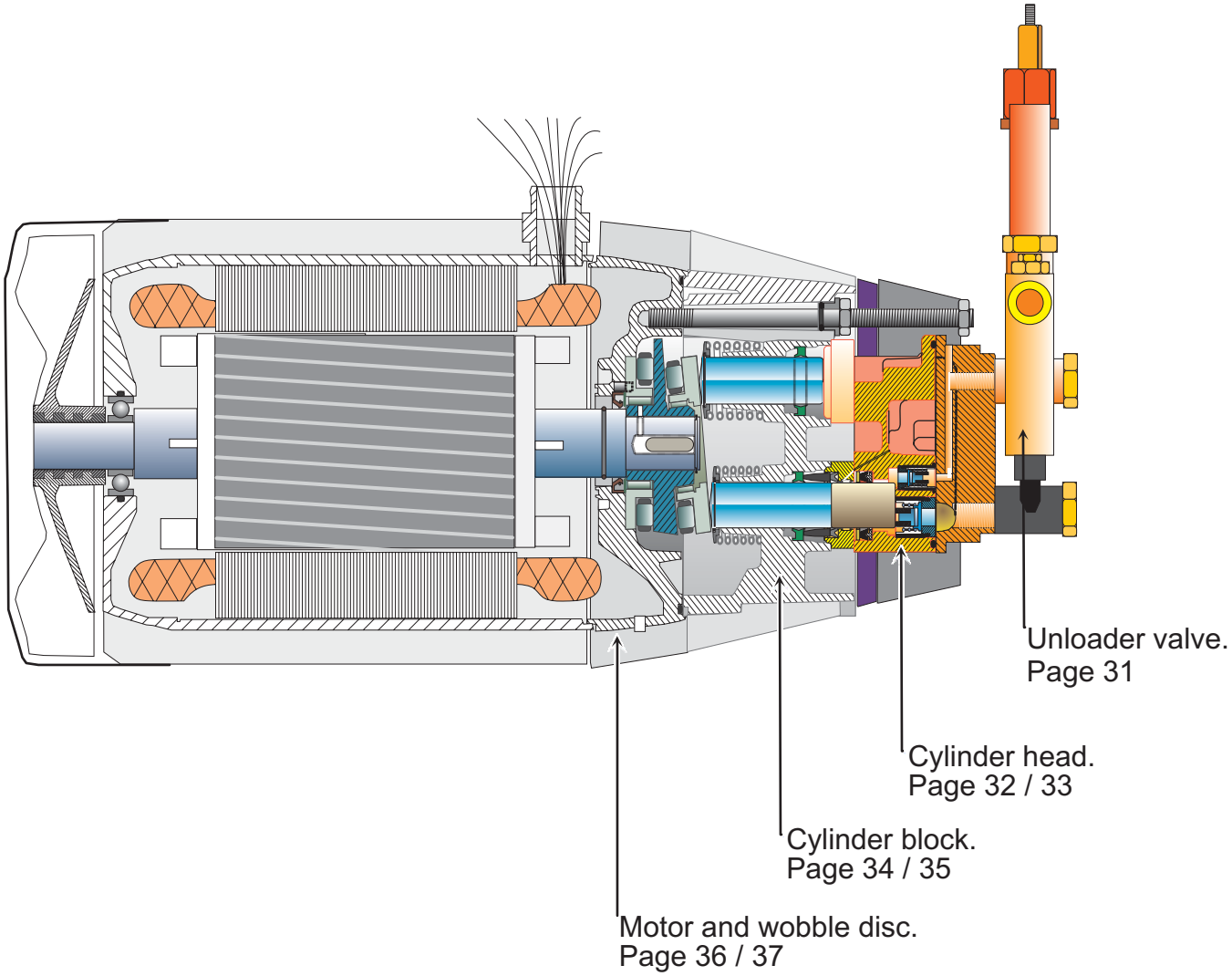
Reason: Water supply inadequate, water temperature too high or water filter (2) dirty.

NB: The pressure of most water supplies varies depending on the actual consumption. A test of the water pressure should therefore be carried through when there is a heavy consumption. The pressure must under no circumstances drop below 1 bar.

The machine starts / stops by itself

Reason: Leak on the high pressure side or in the non-return valve.

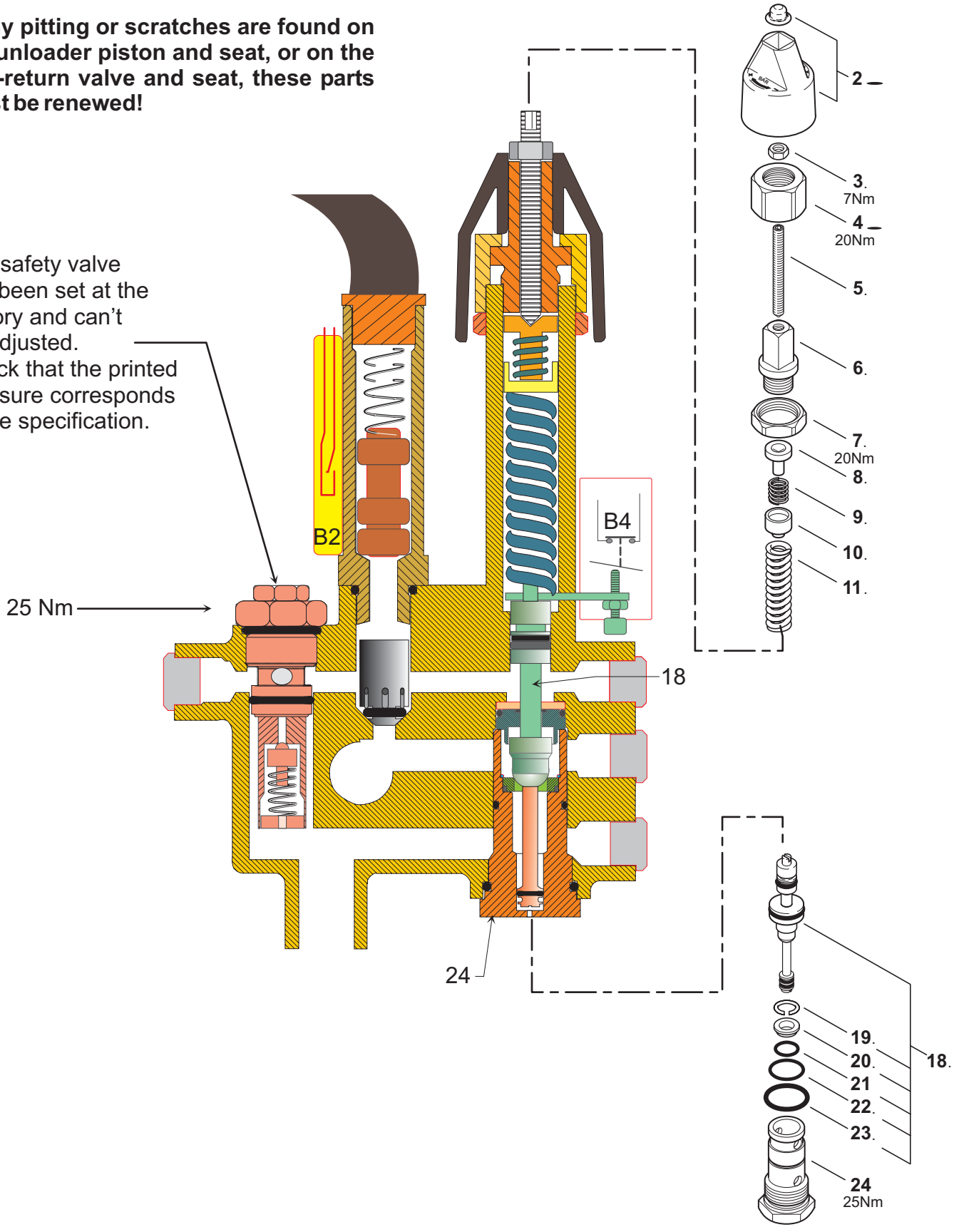
NB: If the machine has been operated with hot water, a cooling of the hose may cause the machine to start / stop a couple of times before stability has been reached.


Unloader valve.
Page 31
Cylinder head.
Page 32 / 33
Cylinder block.
Page 34 / 35
Motor and wobble disc.
Page 36 / 37

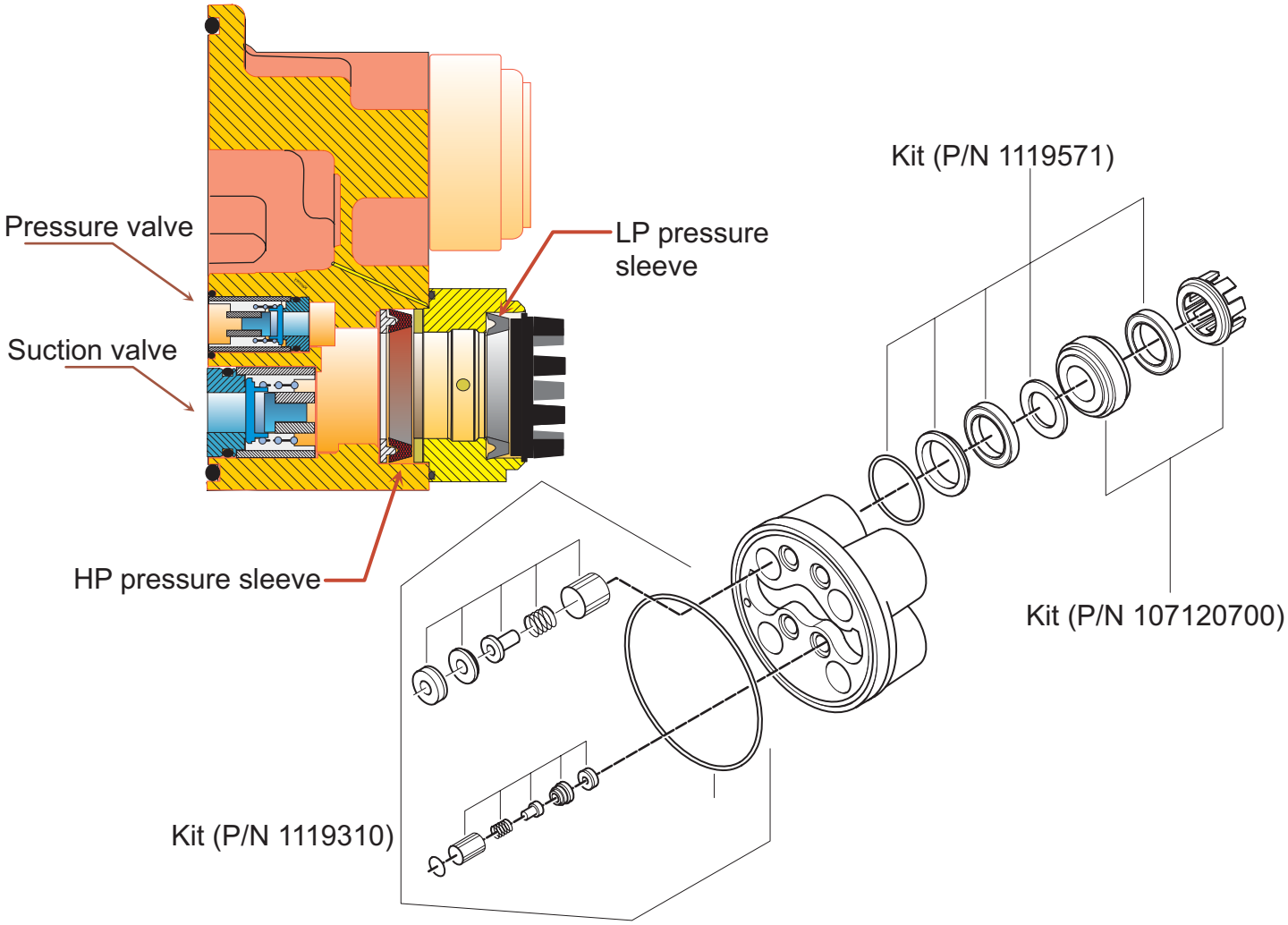
Control Safety Block

If any pitting or scratches are found on the unloader piston and seat, or on the non-return valve and seat, these parts must be renewed!

The safety valve has been set at the factory and can't be adjusted. Check that the printed pressure corresponds to the specification.



C3 Cylinder head 1



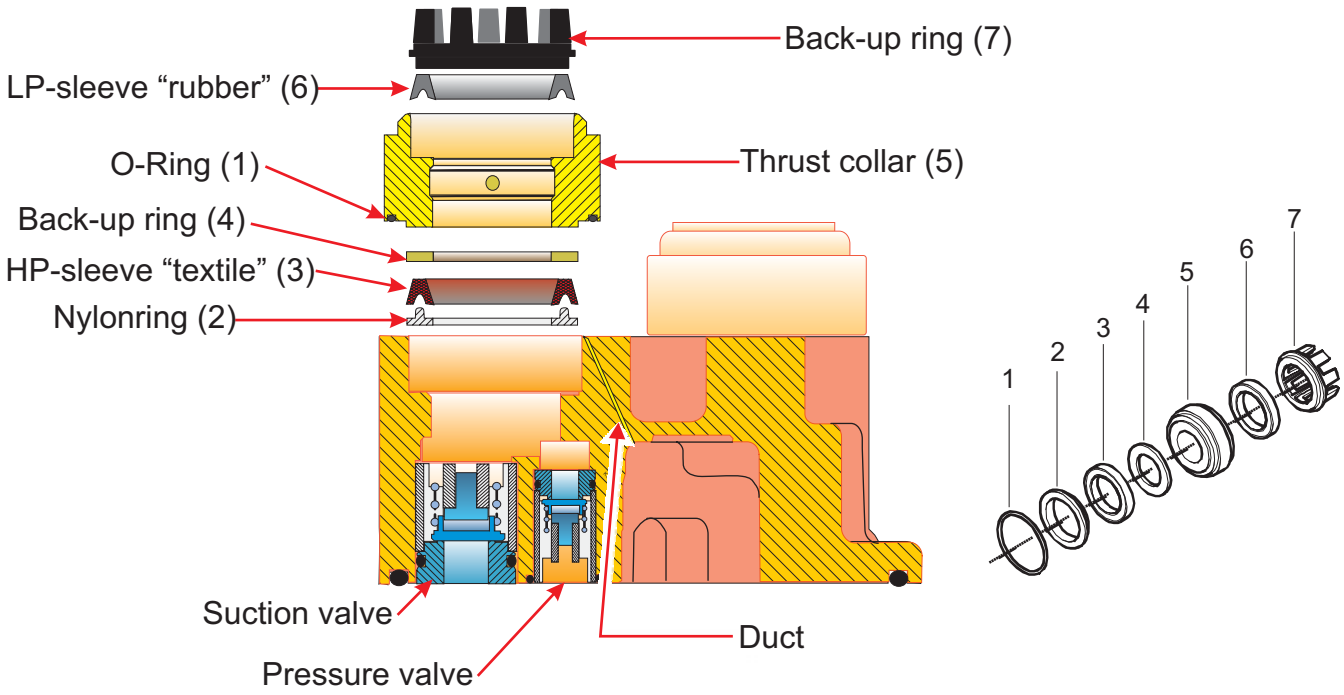
Dismounting and mounting by hand. Attach the big O-ring using grease. Note position of the casting "smile". Tighten the eight 10 mm nuts with 27 Nm.

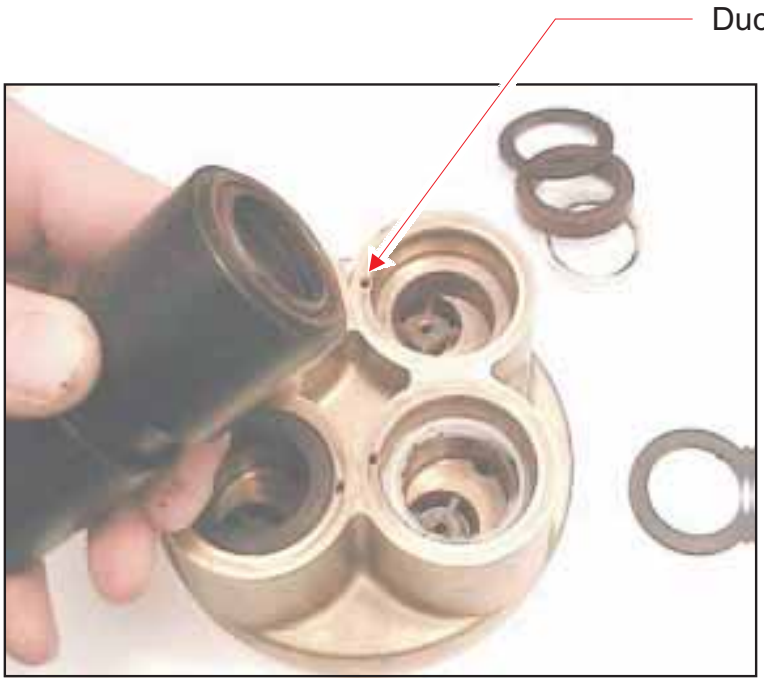
Pic. 6.1: C3 pump with removed cylinder head

Dismount suction valve seat with a mandrel. Now press out the pressure valve with a 2 mm punch. Check the surface of the seats. Mounting only by hand.

Pic. 6.2: Dismounting suction valves

C3 Cylinder head 2

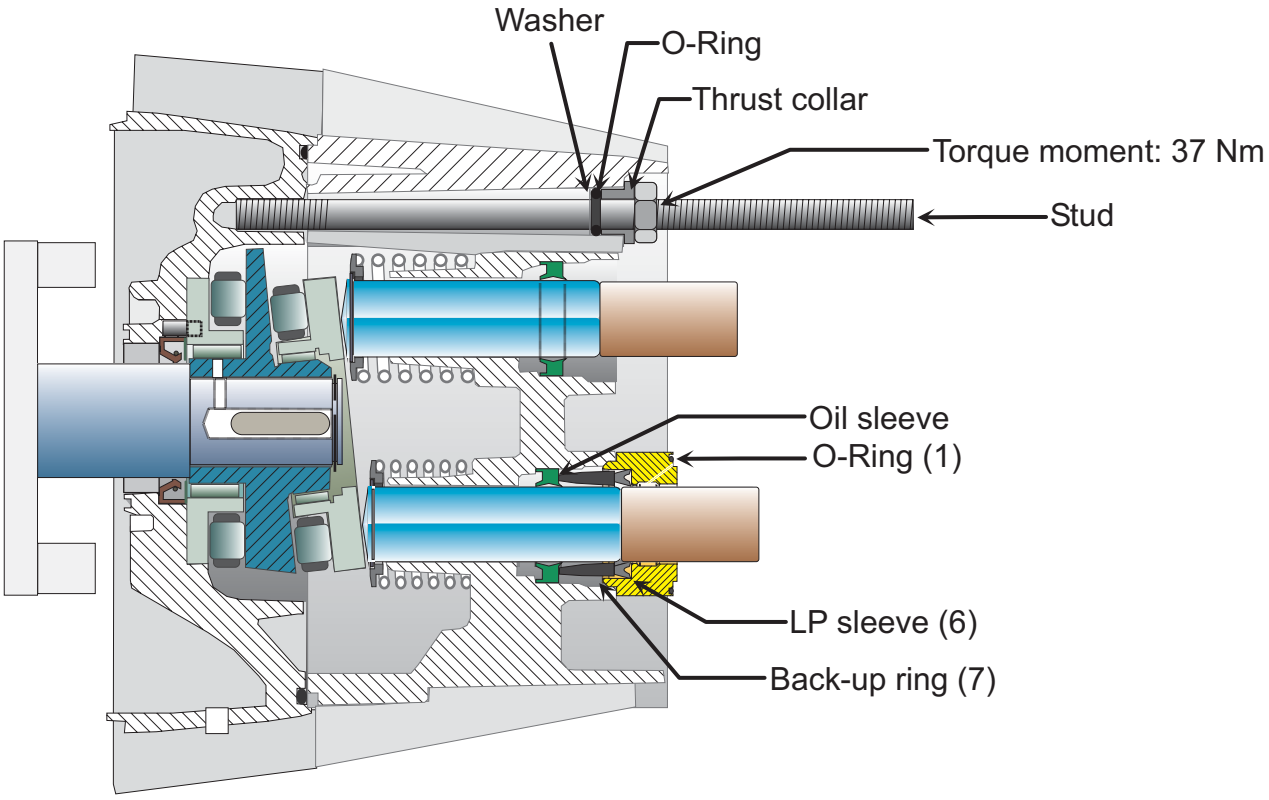




Pic. 6.3: Mounting pressure sleeves

Mounting of textile sleeves by means of tool P/N 1220090. It is an advantage if the sleeves have been in a water bath for 3-4 hours before mounting them. Do not forget to blow through the ducts and grease all sleeves before mounting.
Don’t scratch the brass cylinder head when removing the old HP sleeves!

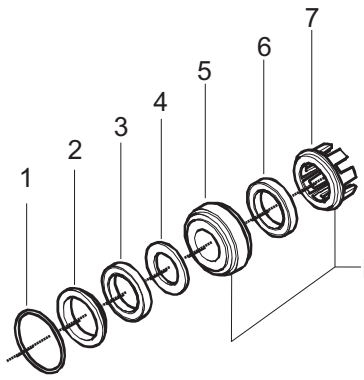
C3 Cylinder block 1

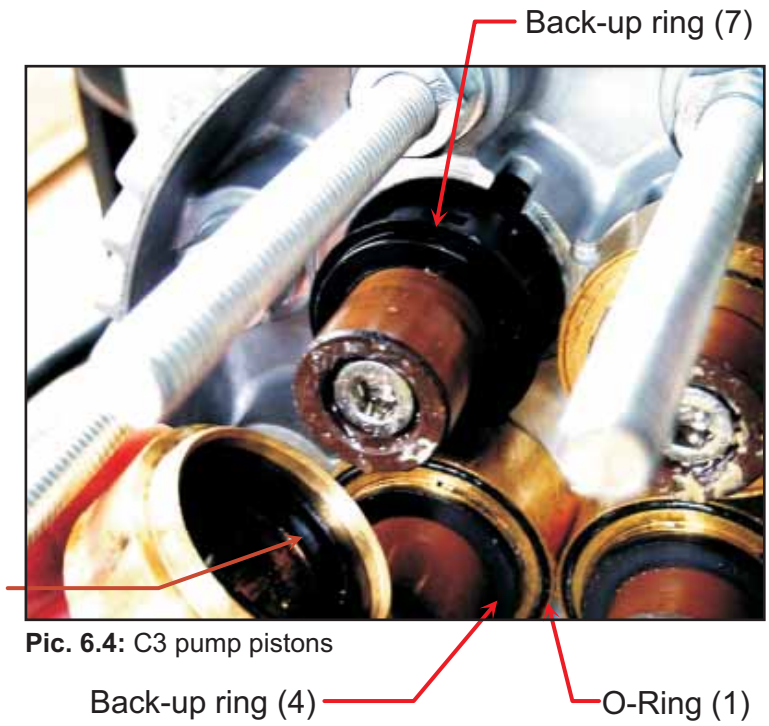


Drain the oil. Loosen the 8 nuts gradually and evenly (because of the spring load). Special extra-deep 17 mm box head P/N 1206762 may be used.

Mount new O-Rings on studs with tool P/N 1206812. **Sliding the O-Rings over the threads will cause oil leaks!**

Always replace LP sleeves when replacing HP sleeves. Check that the ducts are clear.





Pic. 6.4: C3 pump pistons

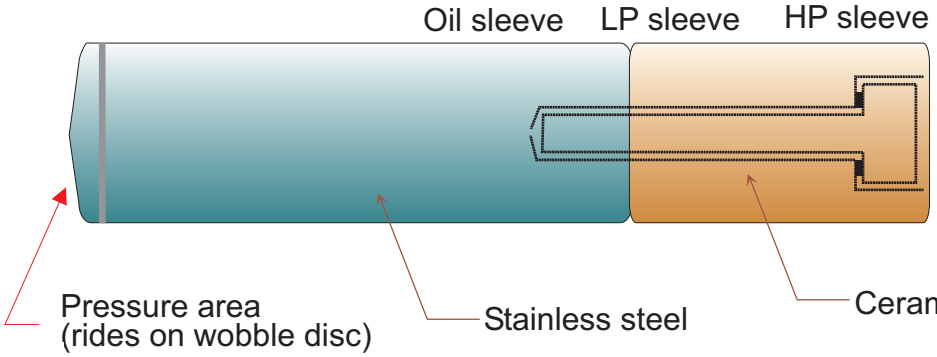
Kit 16 consists of two new parts, the "crown" (back-up ring) and the thrust collar. They must always be replaced at the same time.

Carefully tip out the oil sleeves with an adequate screwdriver and discard them. Be careful not to scratch the surface.

Pic. 6.5: Dismounting oil sleeves

Before mounting the new sleeves, it will be a good idea to moisten the sleeves with soapy water. Mount new oil sleeves with punch P/N 1220429. Carefully knock or press them home.

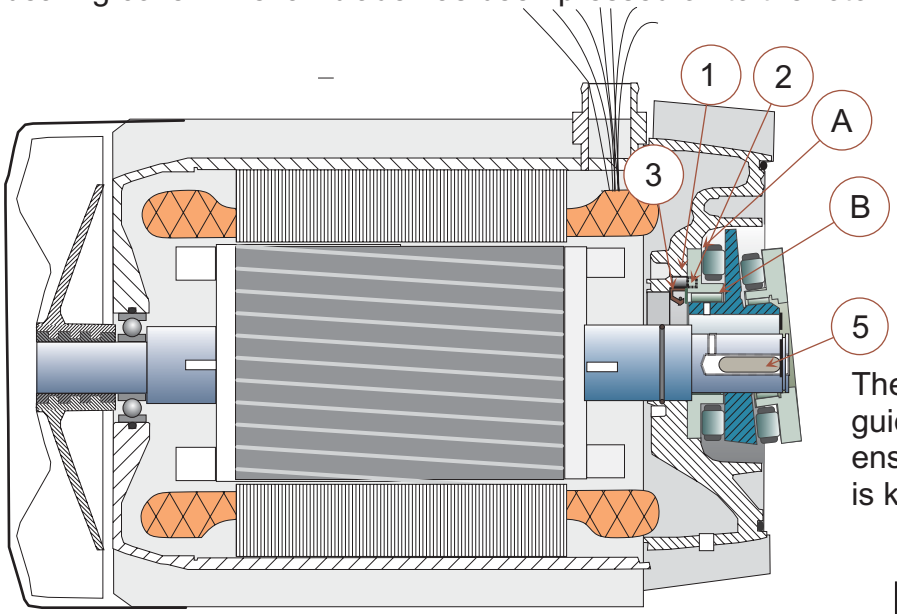
Pic. 6.6: Mounting oil sleeves



Check the piston for wear in the pressure area and the area of the oil sleeves. Check the ceramic for cracks. Remove any coating.

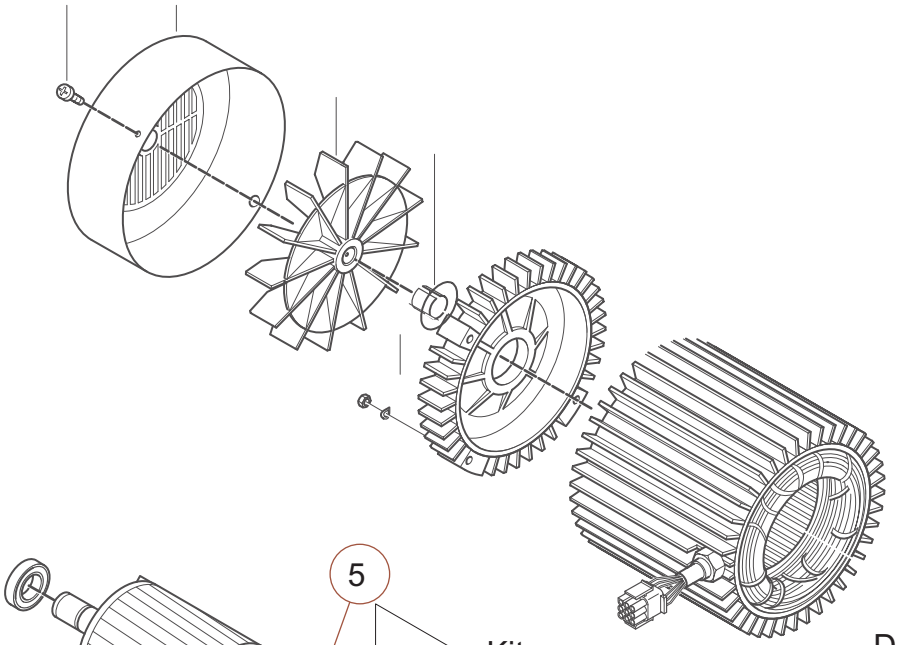
Motor / Wobble disc 1

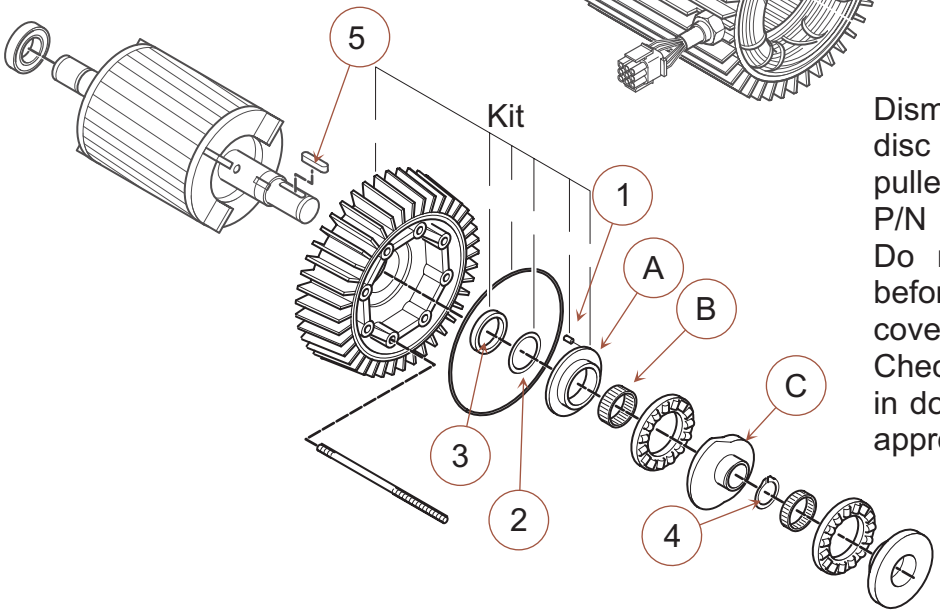
The motor consists of a stator with windings and a rotor with shaft which is kept in the right place by a bearing in the N bearing cover and the inner needle bearing of the wobble disc in the D bearing cover. The fan blade has been pressed on to the rotor with an internal locking ring.



The bearing track (A) is fixed with a guide pin (1). The washer (2) ensures that the needle bearing (B) is kept free of the oil sleeve (3).

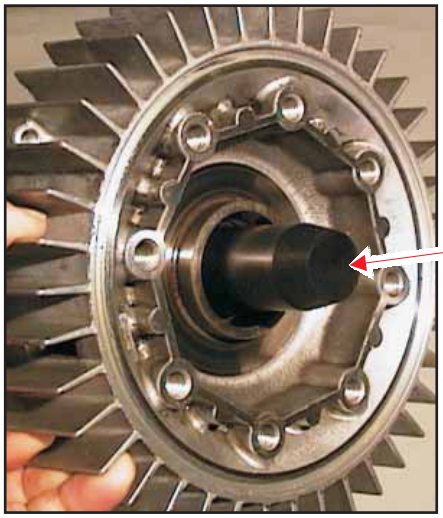
Pic. 6.7: Removing the wobble disc





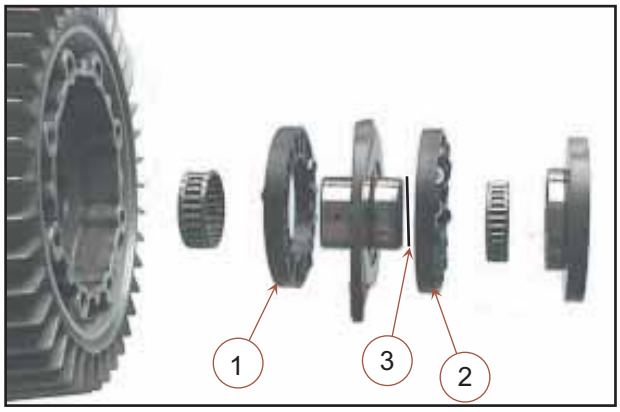
Dismount circlip ring (4). The wobble disc (C) is easily dismountable with puller P/N 1205715 and special legs P/N 1206150 / 1206168 (Pic. 6.7). Do not forget to remove key (5) before dismounting the D-bearing cover.
Check bearing surfaces for wear. If in doubt, replace kit completely after approximately 2000 hours.

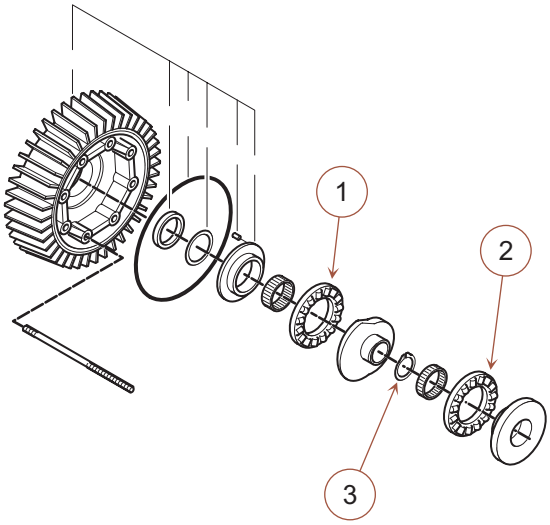
Motor / Wobble disc 2



When mounting the D-bearing cover completely, protect the U-sleeve with tool P/N 1206598 which is placed on the shaft before placing the cover.

Pic. 6.8: Mounting D-bearing cover





Pic. 6.9: Exploded view of wobble disc and its bearings

When mounting the wobble disc, lubricate the bearings with oil. The big axial roller bearings (1) and (2) are identical. Do not forget to mount the circlip ring (3) on the shaft. Refill with 1 l oil type **Castrol Alphasyn-T ISO 150** or **BP Bartran HV ISO 100**.

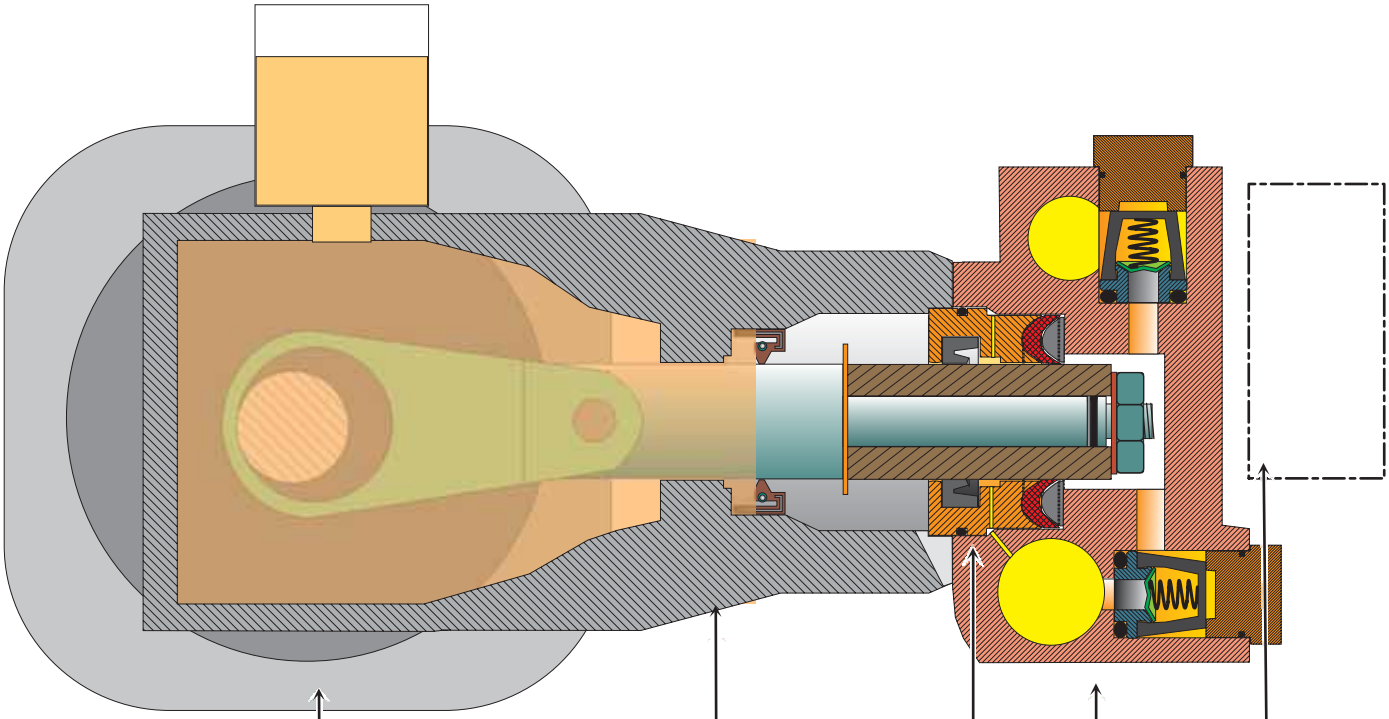
Pic. 6.10: Wobble disc & bearings

Pic. 6.11: Bearing track & piston

Check the bearing surfaces for wear. As long as the surface is even and shiny without pitting or grooves, the wobble disc can be re-used.

NB: The illustrated bearing track (Pic. 6.11) has been working for more than 3000 hours with a pressure of 180 bar. It is now ready to be changed.

NP5 Survey



Control Safety Block.
Page 39

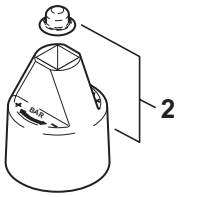
Valve cover & seals.
Page 40 / 41

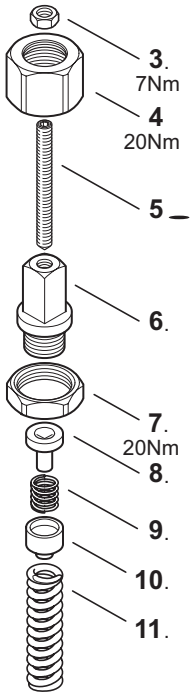
Pistons & oil seals.
Page 42

Pump housing.
Page 43

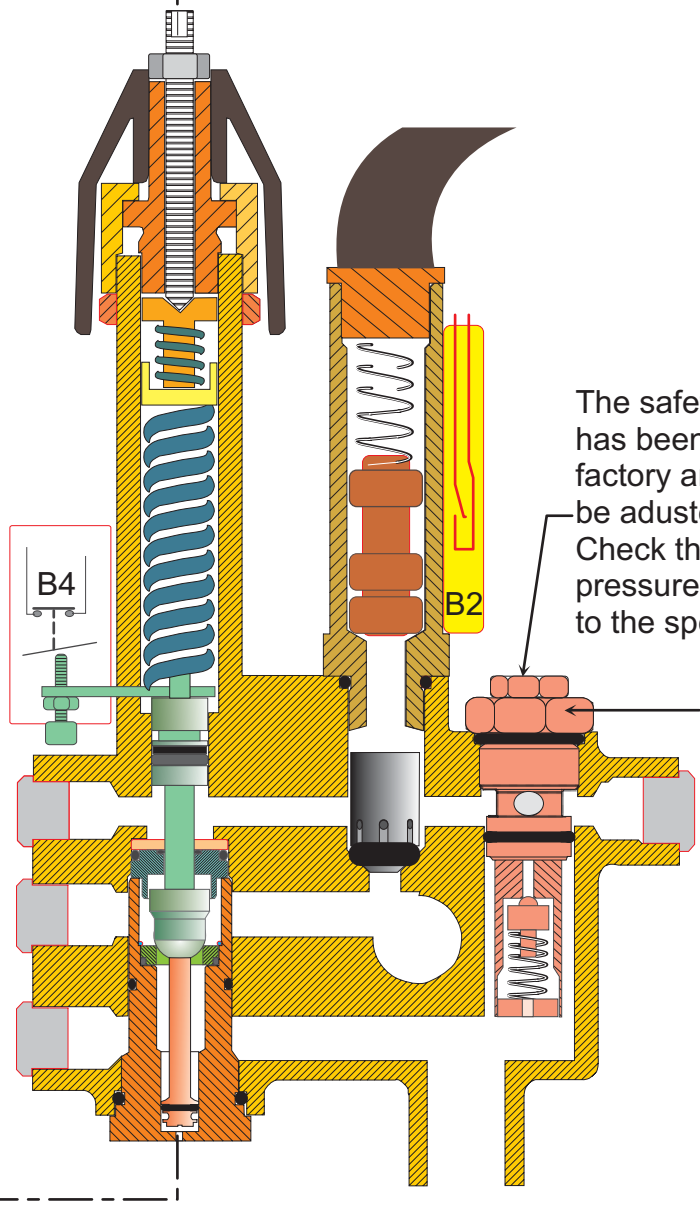
Motor.
Page 43

Control Safety Block



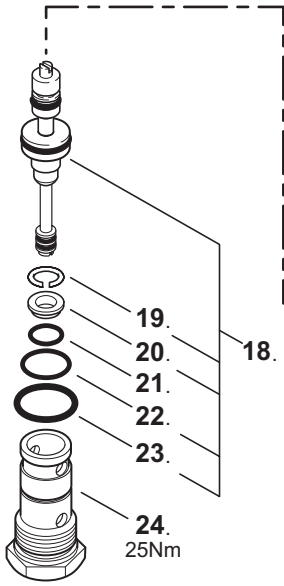


If any pitting or scratches are found on the unloader piston and seat, or on the non-return valve and seat, these parts must be renewed!

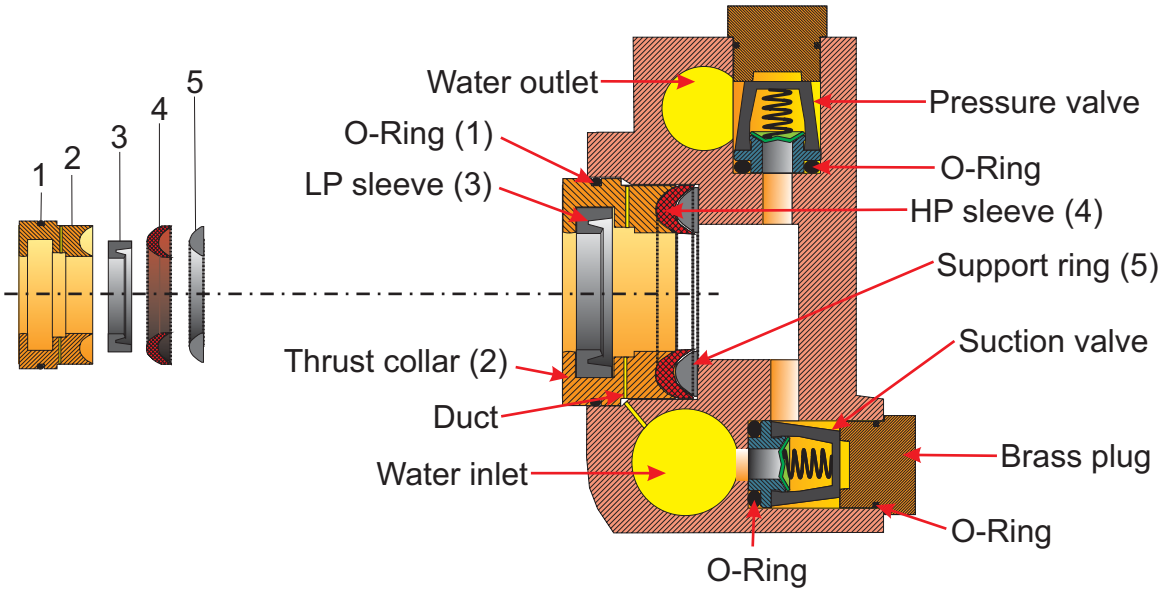


The safety valve has been set at the factory and can't be adusted. Check that the printed pressure corresponds to the specification.

25 Nm



NP5 Pump head 1



Pic. 6.12: NP5 Cylinderhead

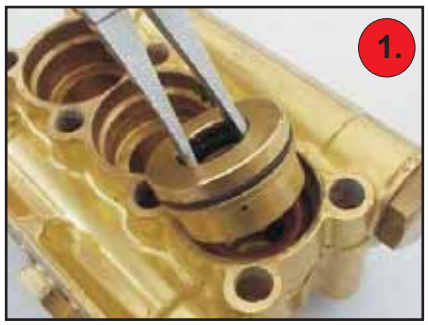
Dismount the brass plug on the cylinder head with a 21mm fixed spanner and remove the valves. Do not scratch the inside of the valve chamber during removal!

When you replace the valves give the O-Rings an inspection for damage before mounting.

Pic. 6.13: Pressure valve

Pic. 6.14: Suction valve

NP5 Pump head 2 & seals



Pic. 6.15: Dismounting thrust collar

1. Be careful when you dismount thrust collar (Pic. 6.15) because you can easily damage the surface inside.
Give the thrust collar an inspection before mounting.

Pic. 6.16: Mounting HP sleeve & support ring

2. When mounting the sleeves and the support ring (Pic. 6.16) remember lubricating.

Pic. 6.17: Removing LP sleeve

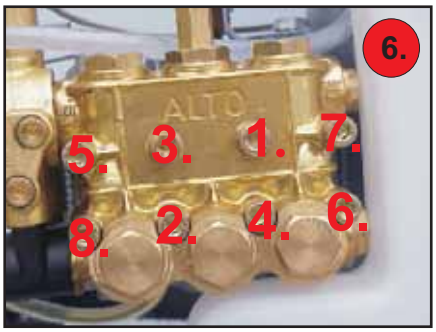
3. When dismounting the LP sleeves, use a screwdriver to tip out the sleeves (Pic. 6.17). Do not re-use the them!

Pic. 6.18: Mounting LP sleeve

4. Clean the thrust collar and lubricate before mounting the sleeves (Pic. 6.18).

Pic. 6.19: Mounting thrust collar

5. Inspect the the thrust collar for marks, lubricate and mount it with your fingers (Pic. 6.19).



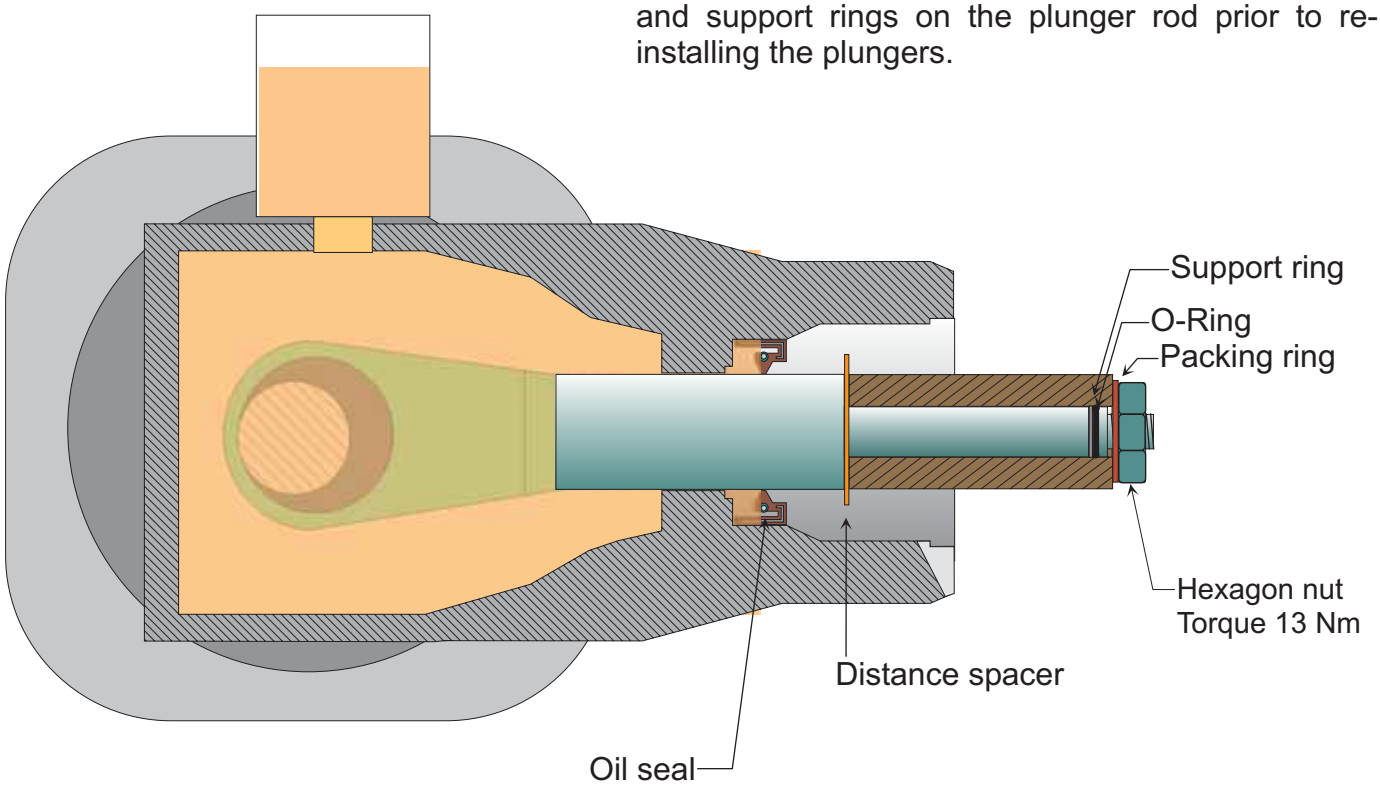
Pic. 6.20: Mount cylinder head

6. When you mount the cylinder head tighten the bolts in the shown sequence (Pic. 6.20). Use a 6 mm hexagon wrench with a torque of 20 Nm.

To inspect the plunger for cracks:

Spray the inside of the plunger with fast evaporating cleaner such as a brake cleansing agent. The brake cleansing agent will take a second longer to evaporate from the crack, thus making the crack visible.

Carefully inspect and replace as needed O-Rings and support rings on the plunger rod prior to re-installing the plungers.



Also clean the distance spacer before re-installing the plungers.

Do not re-use the packing rings!

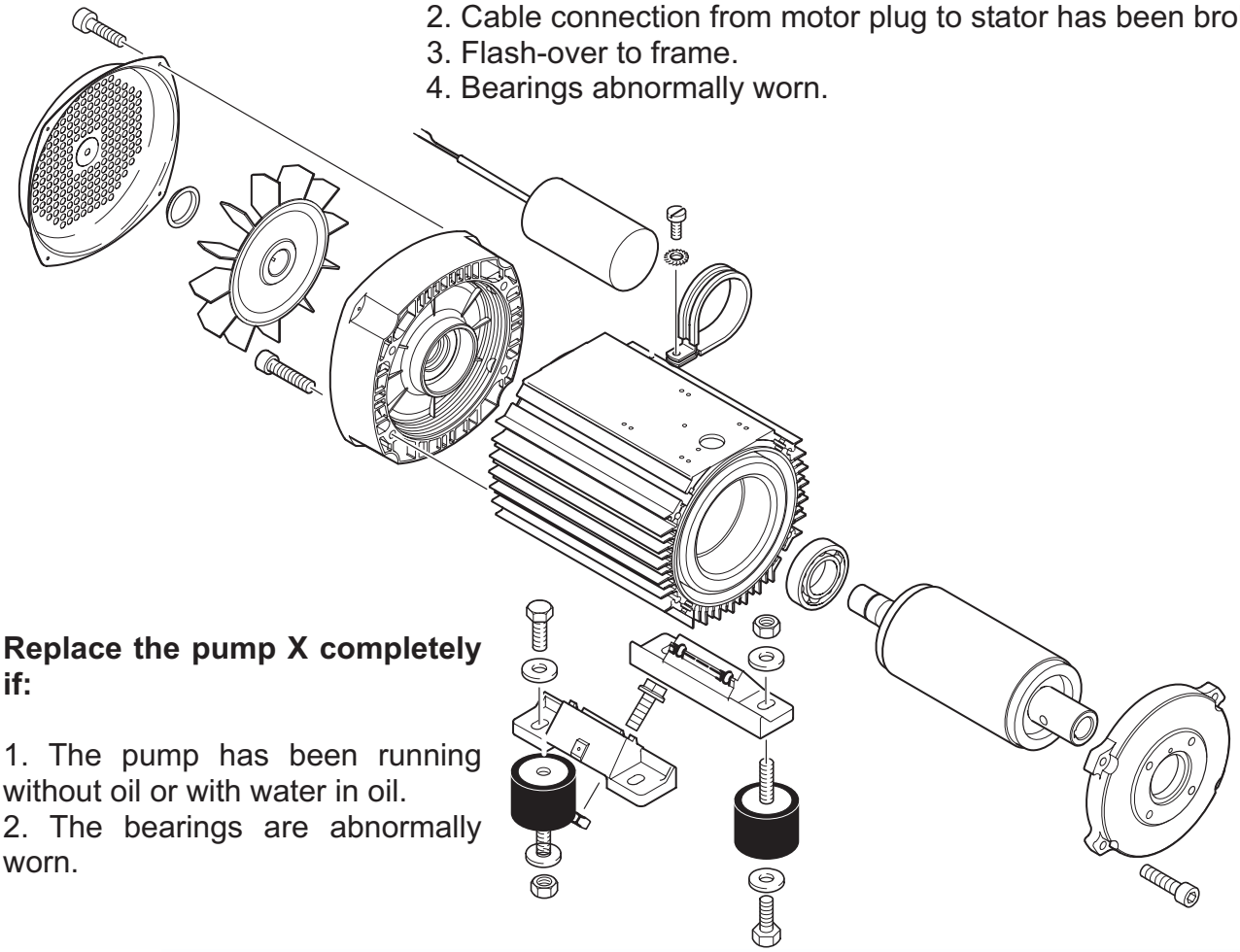
Use one drop of medium strength thread locker on each plunger rod when re-installing hexagon nut and a torque of 13 Nm.

Oil seals must be changed if there are any signs of leaks or if they are removed. The recommended way to remove the oil seals which are pressed into the pump body is to puncture the seal with an awl and pry down.
When installing new seals, a light coating of lubricant on the seals may ease the installation. Make sure it is pressed in using equal pressure around the entire circumference.

Pump house & motor

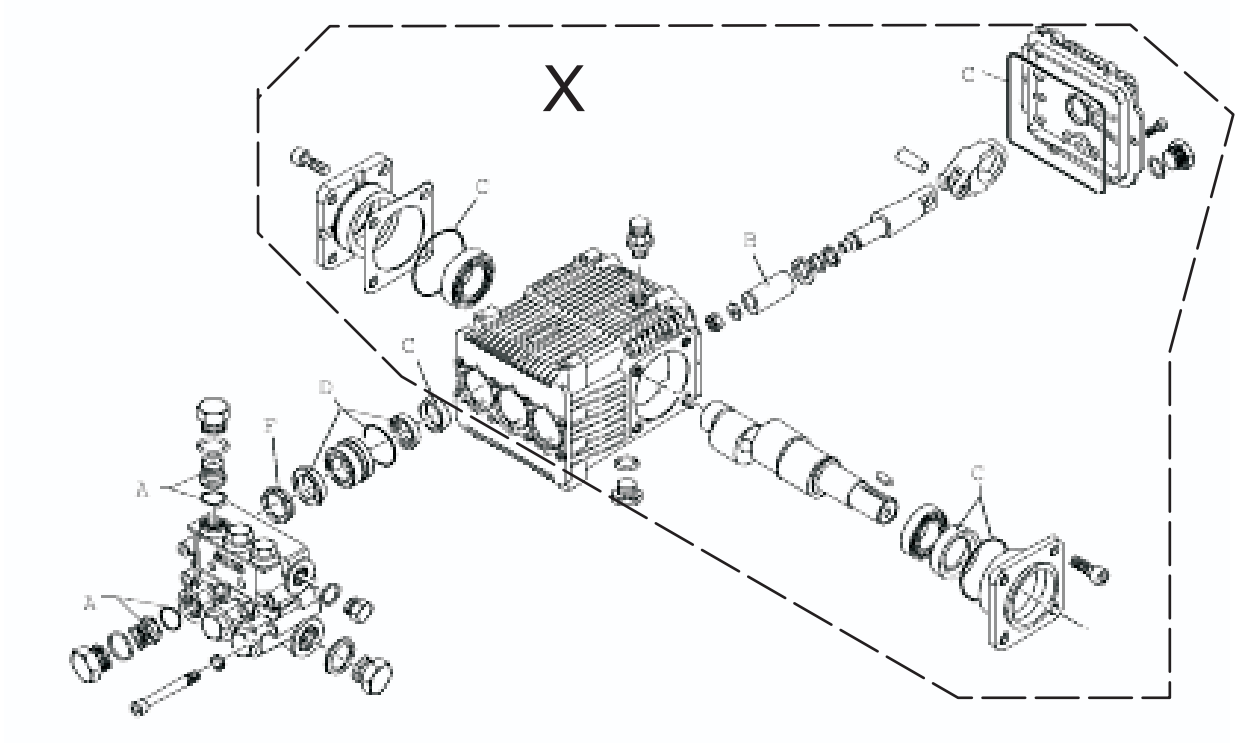
Replace the motor completely if:

1. One or more windings have burned or broken.
2. Cable connection from motor plug to stator has been broken.
3. Flash-over to frame.
4. Bearings abnormally worn.

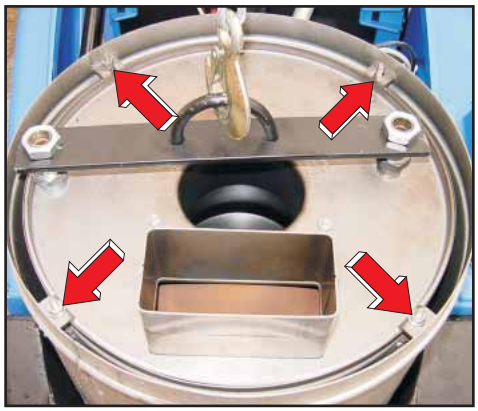


Replace the pump X completely if:

1. The pump has been running without oil or with water in oil.
2. The bearings are abnormally worn.

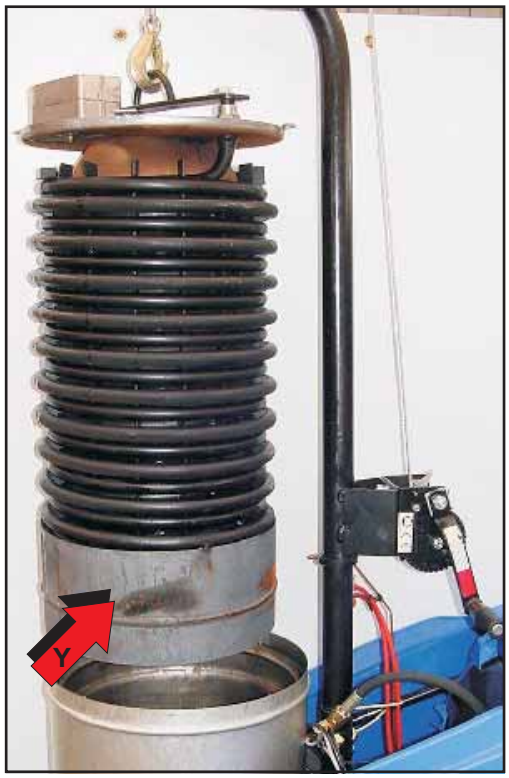


Heat exchanger removal



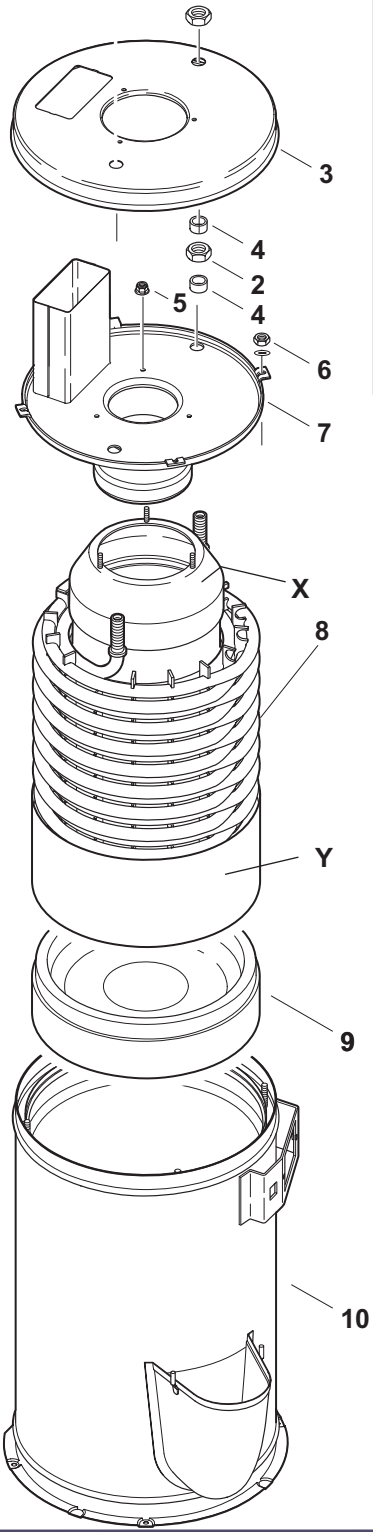
Pic. 6.21: Hooking up the heat exchanger coil

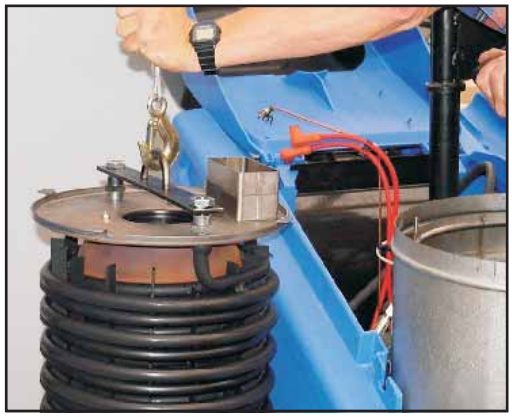
With a special designed service crane P/N 301001078 it's no longer necessary to remove the coil by hand. Just put up the crane to the central tube and disconnect all connections attached to the heat exchanger and burner. Then remove burner and outer heat exchanger cover. Mount the lifting tool over the two coil ends and fix it with the nuts. Dismount the 4 nuts (see arrows at Pic. 6.21), hook up the crane and lift out the coil (Pic. 6.22). When landing on the floor press over to the side (Pic. 6.23) or protect the machine with a piece of cardboard.



Pic. 6.22: Lifting up the heat exchanger coil

Check the flame tube X and Y. It is important that they are solid and complete.
Parts X and Y are part of the coil (8) and can't be separated.
Clean the coil with an alkaline detergent by using high pressure. Afterwards rinse with clear water.





Pic. 6.23: Bringing down the heat exchanger coil

<u>Attention:</u> Be aware of the fact that the machine can tip over. Keep the coil close to the machine.

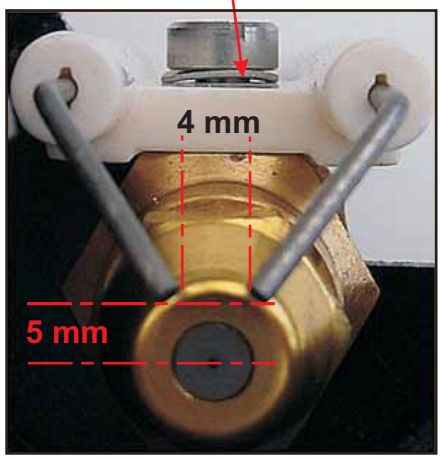
Pic. 6.24: A look inside the coil from underneath

Pic. 6.25: A look inside the heat exchanger jacket from top

Clean up deposits and change the isolation (9) if needed.

Electrodes / tank meter

Pic. 6.26: Electrodes & fuel nozzle

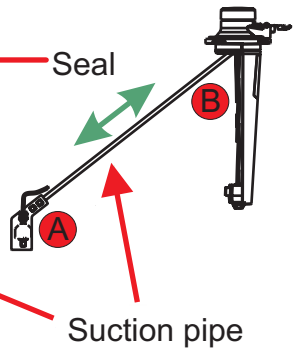


Pic. 6.27: Electrodes & fuel nozzle

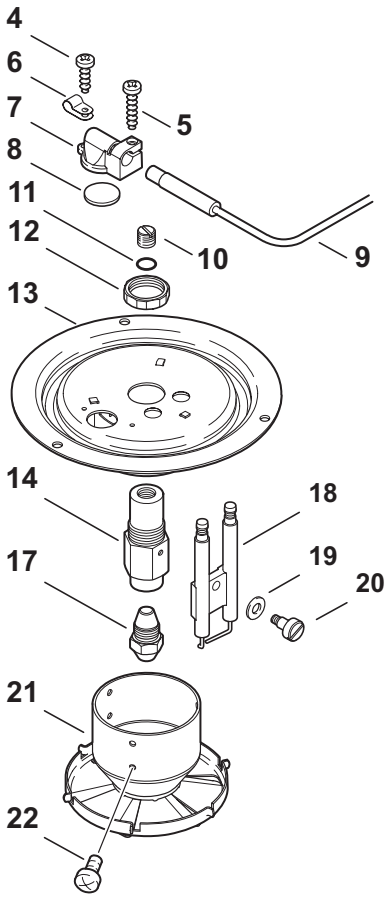
How to handle the burner insert:

- Always remove electordes (18) first while dismounting burner insert.
- Tighten fuel nozzle (17) only with a hexagonal wrench and a torque of 18 Nm. Otherwise the fuel nozzle can be damaged and a proper combustion can't be guarantied.
- Always measure the electrode (18) set-up first and re-adjust if necessary before re-installing burner insert (values see Pic. 6.26 and 6.27).

To insert and remove tank meter, carefully pull back suction pipe (don't bend it!). Float switch moves from point A to B (Pic. 6.28). Also make sure to pull back the cable of the float switch. Now insert / remove the whole unit. Don't forget to bring back float switch to operating position (A) after and make sure that the seal is in place.



Pic. 6.28: Tank meter & fuel float switch



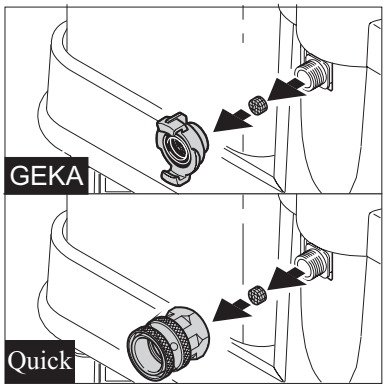
The flame sensor (9) must be fixed with a screw (5) in the right position. **Don't over-tighten!**
Check and clean the glass (8).

Maintenance plan

	Weekly	NEPTUNE 5 only: After the first 50 operating hours	Every six months or 500 operating hours	As required
Water filters				●
Oil filter				●
Checking the pump oil quality	●			
Changing the pump oil		●	●	
Emptying the fuel tank				●

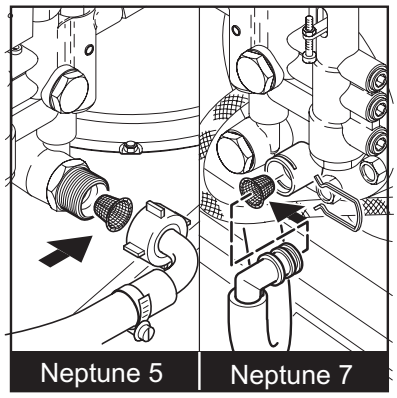
Maintenace work

Water filters



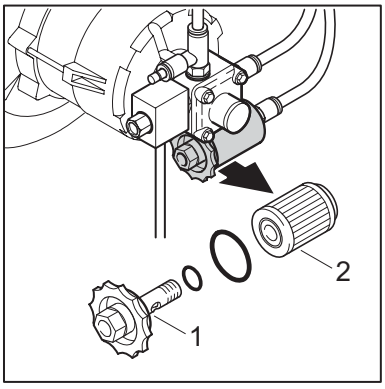
A water filter is fitted on the water inlet to prevent large particles of dirt from entering into the pump.

1. Unscrew Quick / GEKA coupling.
2. Remove filter with tool and clean it.



3. Clean filter at the pump inlet hose.

Oil filter



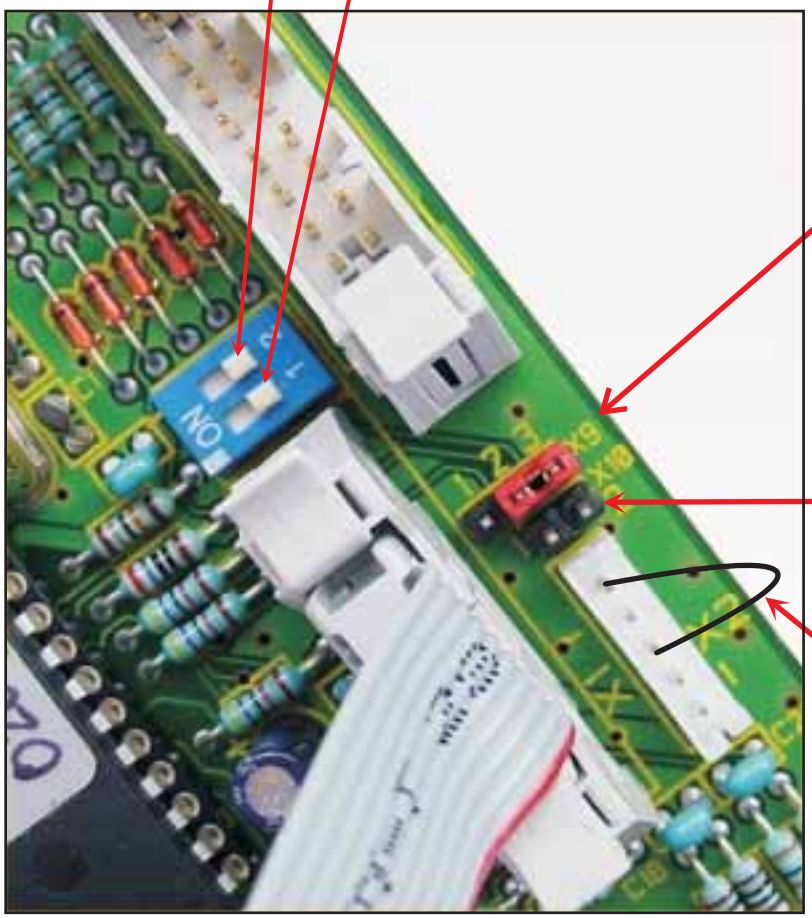
To clean or replace filter:

1. Unscrew filter cap (1)
2. Clean / replace oil filter (2).
3. Dispose of cleaning solution/ replaced filter in accordance with regulations.

Further maintenance work see at the users manual in chapter 7.

Machine cut off with pressure release.
Function used in connection with remote mode. If “2” is on, machine switches off after 20 min. in by-pass mode. A restart is only possible with mainswitch S1. At the same time the ouput of the optional valve Y2 gets power for 10 s to release pressure at the HP outlet.

Change temperature display.
When “1” is on it shows temperature in °Fahrenheit on display (NB: it’s not possible to cancel by-pass time when temp. display is set to °Fahrenheit).



Hour display setting.
Jumper between 2/3 on X9 shows the total running hours for 5 s on the display during start-up.

Cancel by-pass time.
Jumper on X10 eliminates by-pass time of 20 s, which is necessary when adjusting microswitch B4.

Service interval setting.
Bridge 3 and 5 on X2 while changing service interval with the temperature adjustment knob (100 to 600 hours). Change to hotwater mode to set new setting.

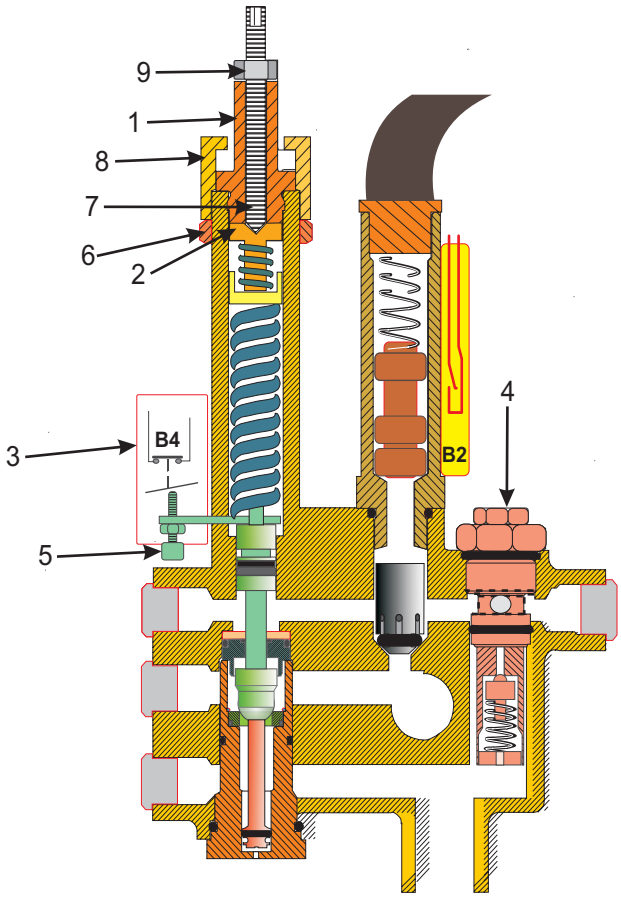
Pic. 7.1: Detail of PCB A1

Attention: Adjustments have to be done with correct nozzle for the machine!

Pic. 7.2: CSB with test pressure gauge

Preparation:

- Make sure machine is switched off and pressure is released
- Mount test pressure gauge directly on the outlet hose of the pump (see Pic. 7.2) or alternatively connect gauge (P/N 49473 with hose P/N 60141) at the water input of the coil where built in gauge is connected
- Open electrical box and cancel by-pass time (20 s) by setting jumper on X10 (temp. setting has to be set to °C otherwise by-pass time can't be canceled)
- Remove safety valve (4) and screw in test bolt (P/N 63138)
- Turn adjustment knob (not shown in Pic. 7.2) as far as possible to right
- Remove adjustment knob after removing cap (not shown in Pic.7.2); it's on top of the adjustment knob)
- Turn setscrew (7) to left until it no longer contacts intermediate piece (2)
- Dismount setscrew (5) of the microswitch (3)



Adjusting maximum operating pressure:

- Switch on machine and open trigger gun
- Turn setscrew (7) clockwise until max. operating pressure is reached (see Table 7.1)
- Then turn setscrew counterclockwise until operating pressure starts dropping
- Turn setscrew ½ turn to right again
- Close trigger gun and check max. cut-off pressure (see Table 1). If necessary readjust
- Lock setscrew (7) with lock nut (9)
- Check operating pressure again

NEPTUNE	Operating Pressure Min Bar	Max bar	Cut-Off Pressure Max.	Savety valve (Pmax)
5-25	32	90	110	200
5-27	32	110	130	200
5-42	32	170	195	250
5-49	32	180	210	250
5-57	32	200	230	250
7-25	32	90	110	200
7-63	32	175	205	250

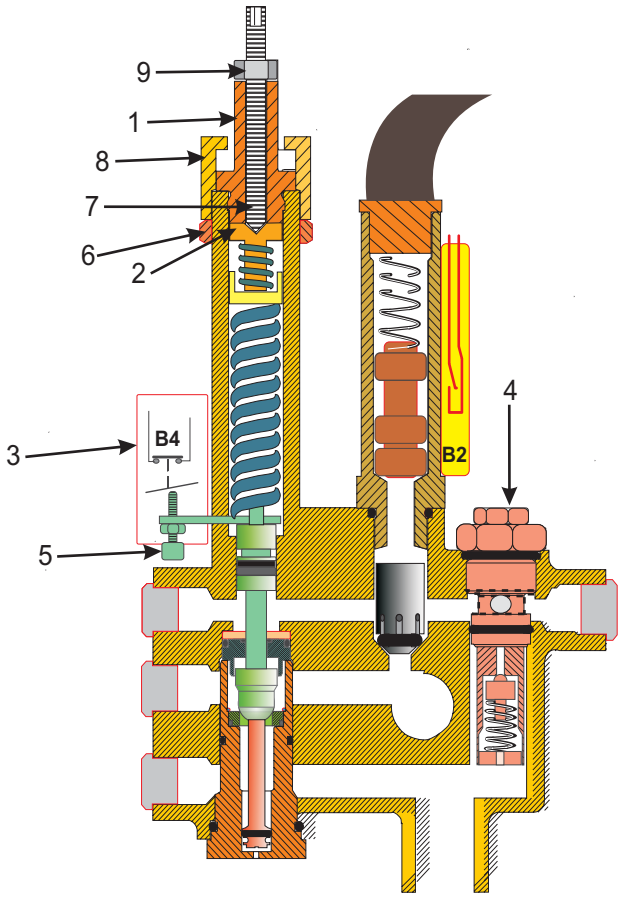
Table 7.1: Neptune 5 / 7 pressure settings

Control Safety Block

Adjusting microswitch (3):

- Switch on machine and open trigger gun. When operating pressure is reached close trigger gun (machine does not shut off)
- After loosening lock nut slowly turn adjustment screw (5) to right until machine shuts off. Then turn ½ - ¾ additional turns in the same direction.
- Lock adjustment screw (5) with nut and sealing paint

Check: After closing gun the lever of the microswitch does not touch the housing!



Adjusting minimum operating pressure:

- Turn adjustment screw (1) to left until minimum operating pressure is reached (see Table 7.1). If necessary, loosen lock nut (6) and turn union nut (8) counterclockwise.
- Then turn union nut (8) to right until it contacts adjustment screw (1)
- Close gun and check function of microswitch (3)
- Lock union nut (8) with lock nut (6)
- Lock lock nuts (6 and 9) and seal with sealing paint
- Fit adjustment knob and secure with cap.
- Also lock cap with sealing paint
- Turn Control Safety Block to max. pressure

Work after adjustments:

- Remove test bolt and mount safety valve (4). Check function at high pressure.
- Remove jumper on X10 and close electrical box.
- Set dip switch 1 back to 0 (only if temperature indication has to be set to °F)

Note: Flow sensor needs to be adjusted with the burner in operation (see burner adjustment procedure)!

Adjusting the burner

1. Remove heat exchanger at least once a year and clean it with high pressure and an alkaline detergent (Combi aktiv).

2. Descale coil if necessary using a descaling agent.

3. Adjust burner insert (dimensions see page 45).

4. Connect fuel pressure gauge (Pic. 7.3) and run machine in hot water mode (continuous operation).

5. Adjust fuel pressure to 12 bar at fuel pump (Pic. 7.4). **Caution:** Always use a new fuel nozzle for adjustment (Table 7.2)! Mount the nozzle with a hexagonal wrench and a torque of 18 Nm.

6. Disconnect fuel pressure gauge.

Pic. 7.3: Measuring fuel pressure

Pic. 7.4: Adjusting fuel pressure

Fuel nozzle			Part number
NEPTUNE 5-25/27/7-25	1.35	60°H	301001068
NEPTUNE 5-42/49/57	1.75	60°H	301000886
NEPTUNE 7-63	2.50	60°H	301000887
Fuel pressure 12 bar			

Table 7.2: Neptune fuel nozzles

Adjusting the flow switch

1. Machine has to run continuously in hot water mode.

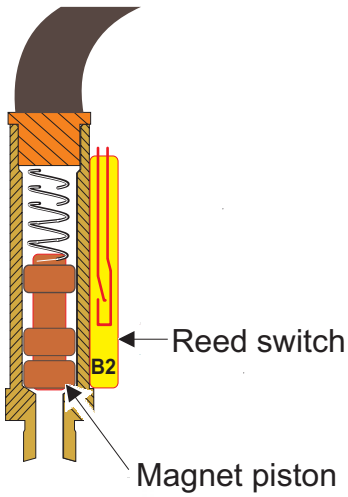
2. Push in reed switch completly and pull it back until burner switches off. Green signal light on operator panel flashes.

3. Slowly push in reed switch within 2 s until burner starts again. Green signal light is on.

4. Repeat procedure if necessary.

5. Adjust machine to min. waterflow / pressure. Solenoid valve must not close in this setting.

6. Finally test the proper function by simulating water shortage. Solenoid valve has to close and shut off the burner.



Combustion

Caution!
Higher CO_2 concentrations at atmospheric pressure differences, different altitudes or temperatures and low quality of the used fuel can lead to a faster accumulation of soot on the heat exchanger coil.

	$C0_2$ (%)	0_2 (%)	Soot
NEPTUNE	11,5 – 12	5,3 – 4,6	0

Table 7.2: CO_2, O_2 and soot setting values

Measuring and adjustment of soot rate

The lateral mounted air flap at the blower is easy to adjust from top with an Allen wrench or a hexagon socket screwdriver by a spindle (Pic. 7.5). The spindle is retained by friction. Turning clockwise means more air, turning counterclockwise means less air.

Pic. 7.5: Adjusting air flap

Caution!
- The values dictated by National Emmissions Control Ordinances have to be kept.
- By adjusting the air flap the soot, CO_2 and O_2 values change.
- Wait until the burner has been running for at least 2 minutes before starting the measurements.
- Air flap needs to be adjusted until the values of table 7.2 are reached!

CO_2 (O_2)-measurement

Set to 11,5% - 12%. If necessary readjust air flap and repeat soot measurement.

Temperature measurement

Flue gas temperature (t_A) minus intake temperature (t_L) gives the temperature differential (Δt).

$\Delta t = t_A - t_L$

Calculating flue gas loss

q_A = flue gas loss

t_A = flue gas temperature

t_L = Intake temperature

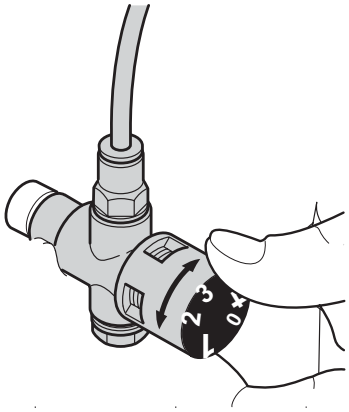
CO_2 = Carbon dioxide content in the flue gass [%]

A1 = Constant for fuel oil 0,5

B = Constant for fuel oil 0,007

$$q_A = t_A - t_L \times ((A1 / CO_2) + B)$$

ALTO AntiStone device



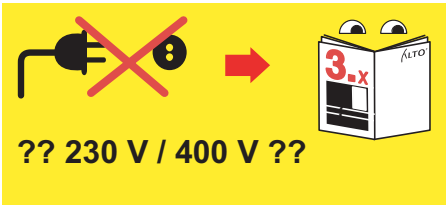
The ALTO AntiStone device is set at the factory to water hardness class 2. Adjustment steps: 1.
Measure the water hardness or ask your water supply company. Read off setting for ALTO AntiStone from the table below and set the adjusting knob to required position.

mg/l	Grains	°dH	°e	°f	ppm Ca	Description	Setting NEPTUNE 5	Setting NEPTUNE 7
0-17	0-1	0-7	0-8,8	0-12,5	0-50	soft	0	0
17-60	1,1-3,5					slightly hard	1	1-2
60-128	3,6-7,5	7-14	8,8-17,5	12,5-25,1	51-150	moderately hard	2	2-3
128-180	7,6-10,5	14-21	17,5-26,3	25,1-37,6	151-300	hard	3	3-4
>180	>10,5	>21	>26,3	>37,6	>300	very hard	4	4

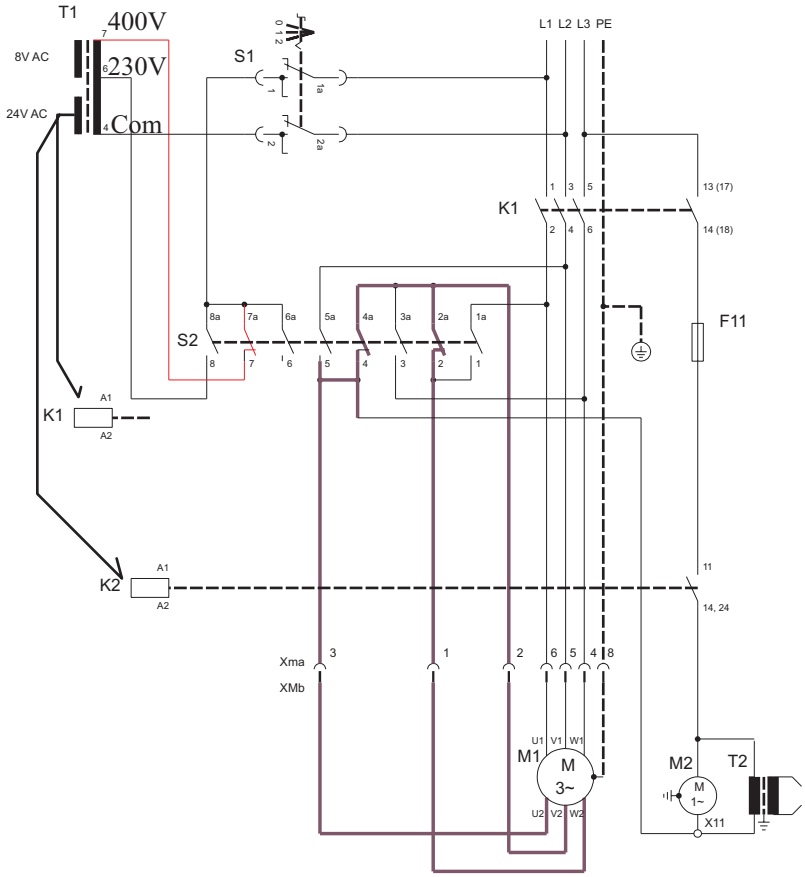
Electrical connection

Some models are equipped with a star delta switch S2 to change between 230 V and 400 V.

Caution!



Before connecting devices with voltage changeover:
Check that the pre-selected voltage on the machine corresponds with the voltage of the electrical installation.
Otherwise the electrical devices of the machine can be destroyed!

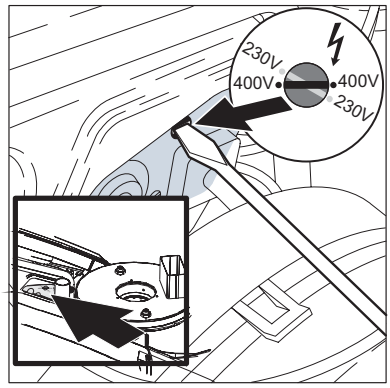


On this diagram the switch S2 is turned into star connection for 400 V.
In this position the transformer is connected to the primary pin 7 (red line).

Three of the motor wires are connected in a star point (thick purple line). The burner motor and ignition transformer are connected to this star point and therefore supplied with 230 V only.

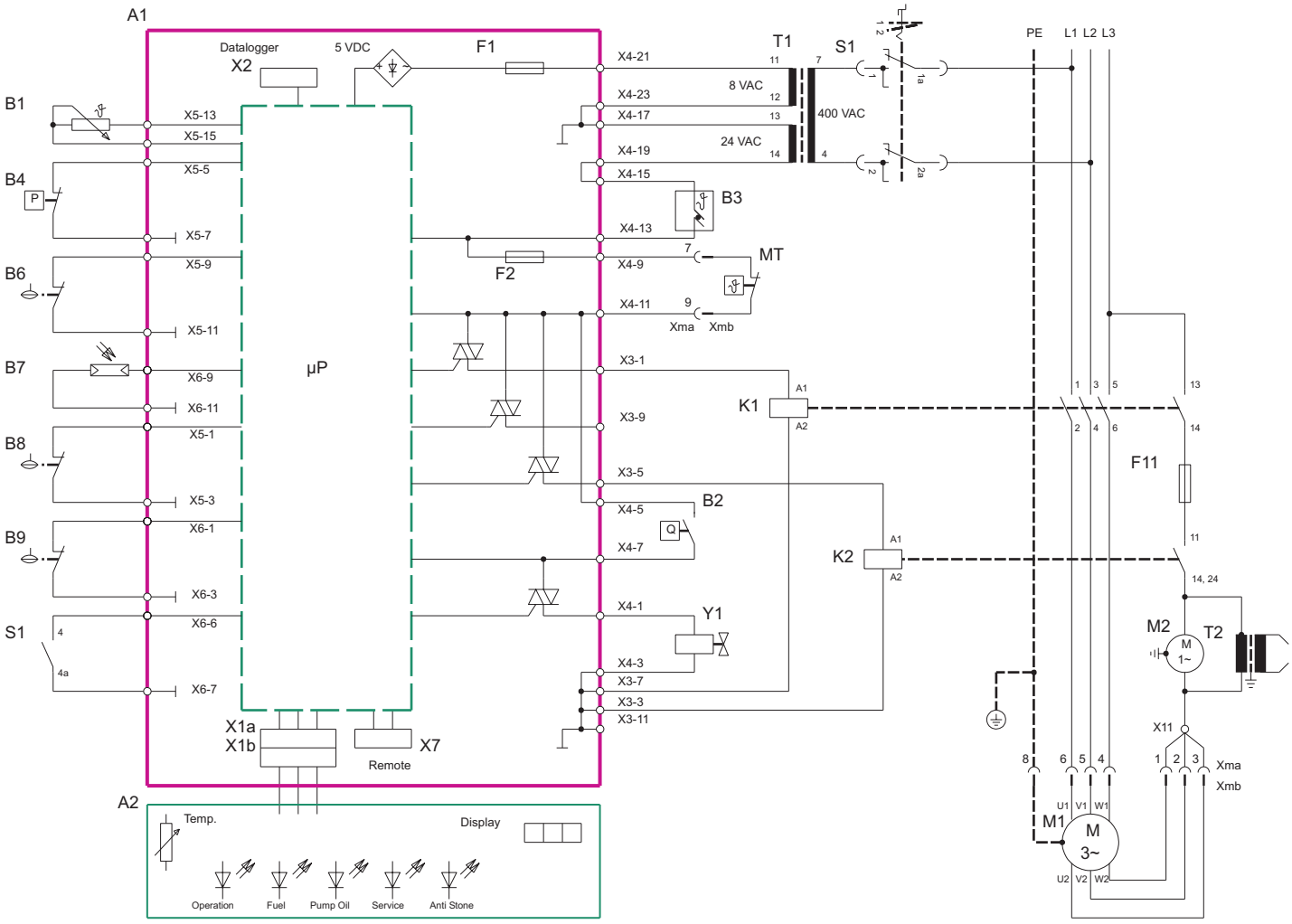
Worst case:
The machine is set for 230 V but supply is 400 V. The motor windings which are made for 230 V are now fed with 400 V.

The burner motor and the ignition transformer are now fed with 400 V.



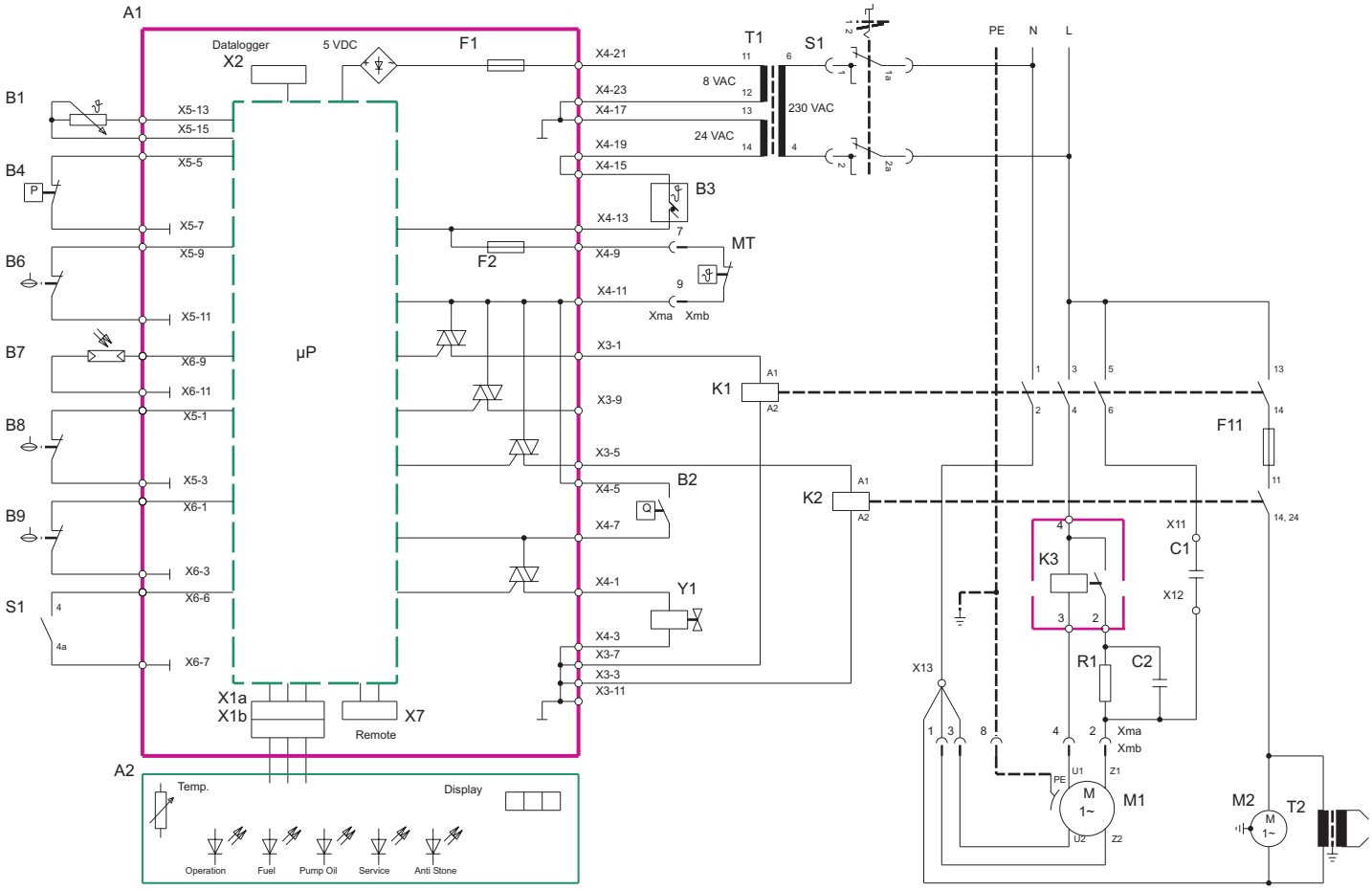
Star / delta switch S2 is located on the backside of the electrical box and easy to adjust with a slotted screwdriver.

3 ~ Star
71246



A1	Processor board
A2	Display board
B1	Temp. sensor
B2	Flow switch
B3	Safety thermal switch
B4	Micro switch
B6	Level switch pump oil
B7	Light sensor
B8	Level switch AntiStone
B9	Level switch fuel
F1/F2/F11	Fuse
K1	Contactor
K2	Relay
M1	Motor 3~
M2	Burner motor
MT	Temp. switch motor
S1	Switch on / off
T1	Control transformer
T2	Ignition transformer
X1a/b	Connector display board
X2	Pin contacts 5-pol. datalogger
X3-X6	Terminal strip
X7	Connector remote control
X11	Concentration terminal
Xma-b	Motor connector
Y1	Solenoid valve

1 ~ phase
71250

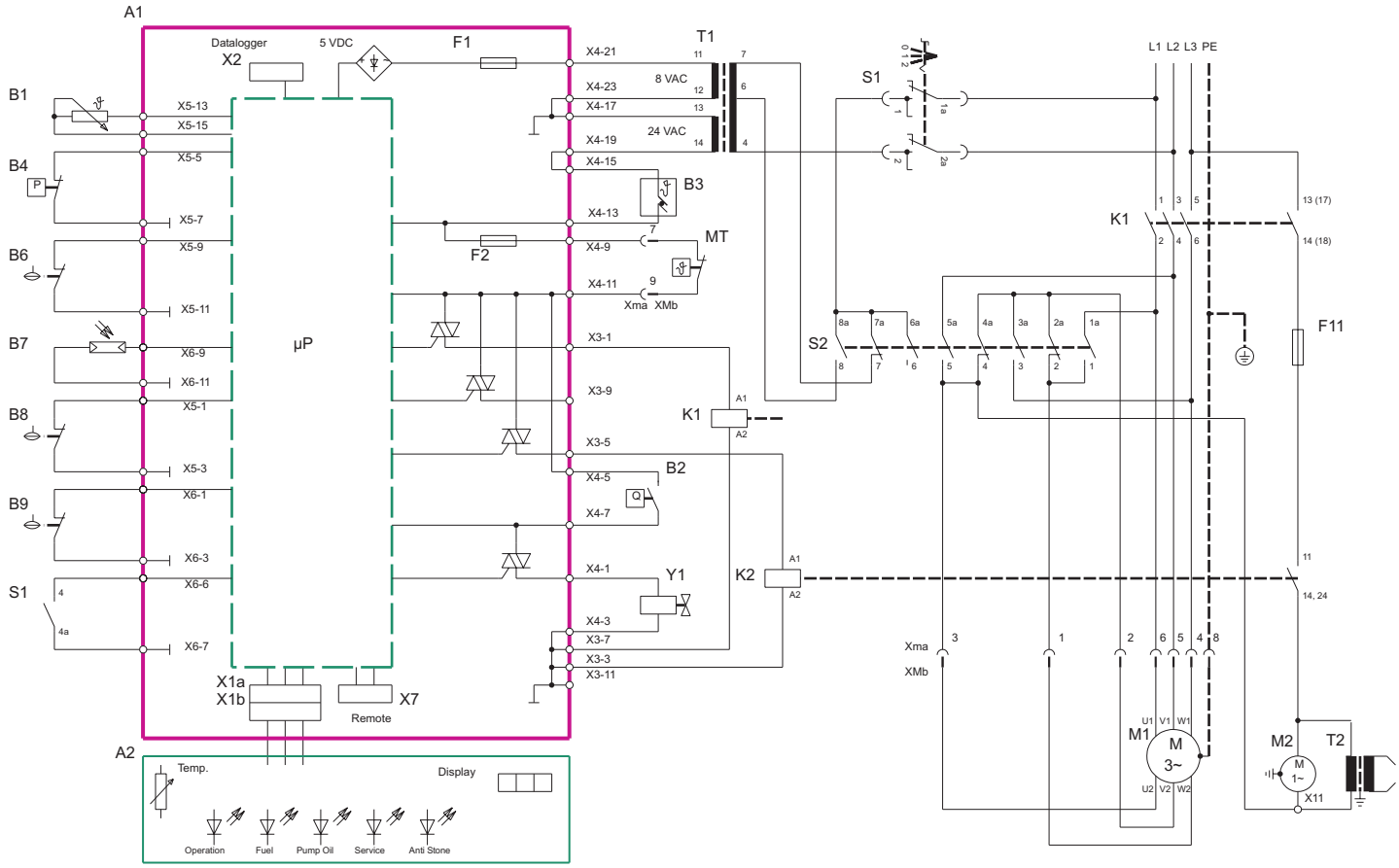


A1	Control board
A2	Display board
B1	Temp. sensor
B2	Flow switch
B3	Safety thermal switch
B4	Micro switch
B6	Level switch pump oil
B7	Light sensor
B8	Level switch AntiStone
B9	Level switch fuel
C1	Operating capacitor
C2	Startingcapacitor
F1/F2/F11	Fuse
K1	Contactor
K2	Relay
K3	Starting relay
M1	Motor 1~
M2	Burner motor
MT	Temp. switch motor

R1	Discharge resistor
S1	Switch on / off
T1	Control transformer
T2	Ignition transformer
X1a/b	Connector display board
X2	Pin contacts 5-pol. datalogger
X3-X6	Terminal strip
X7	Connector remote control
X11/X12	Terminal
X13	Concentration terminal
Xma-b	Motor connector
Y1	Solenoid valve

3 ~ Star / Delta

71261



A1	Processor board	S1	Switch on/off
A2	Display board	S2	Switch star-delta
B1	Temp. bensor	T1	Control transformer
B2	Flow switch	T2	Ignition transformer
B3	Safety thermal switch	X3-X6	Terminal strip
B4	Micro switch	X2	Pin contacts 5-pol. datalogger
B6	Level switch pump oil	X3-X6	Terminal strip
B7	Light sensor	X7	Connector remote control
B8	Level switch AntiStone	X11	Concentration terminal
B9	Level switch fuel	Xma-b	Motor connector
F1/F2/F11	Fuse	Y1	Solenoid valve
K1	Contactor		
K2	Relay		
M1	Motor 3~		
M2	Burner motor		
MT	Temp. switch motor		

Special tools

P/N	Name	Neptune 5	Neptune 7
17237	Soot pump with filter paper and soot comparison chart	●	●
17238	Filter paper (spare)	●	●
17239	Soot comparison chart	●	●
17241	CO2 test liquid	●	●
17242	Exhaust air thermometer (Manual)	●	●
17243	Measurement suitcase	●	●
17246	Oil-pressure testing	●	●
17249	CO_2 measurement equipment with spare test liquid	●	●
40471	Exhaust air thermometer (Electronic)	●	●
40472	Exhaust air effeciency calculator	●	●
1205715	Puller		●
1206598	Cover		●
1206614	Seal assembling tool		●
1206762	Special extra deep 17 mm box head		●
1206812	Assembling tool - stud O-Rings		●
1216506	Assembling tool - suction valve		●
1220090	Assembling tool - pressure sleeves		●
1220429	Assembling tool - oil sleeves		●
301000383	Datalogger	●	●
301001078	Crane with lifting bracket	●	●
301001089	Chimney adapter	●	●
301001090	Crane eye	●	●
1206150 / 1206168	Special legs for puller		●
49473 / 60141	Pressure gauge / HP hose (test pressure gauge)	●	●

Table 9.1: Special tools

- With the datalogger (P/N 301000 383) you can read out: motor starts, motor running hours (run-mode, by-pass-mode), burner running hours and the current service intervall.
- The CO_2 measurment equipment (P/N 1220429) is a manual measuring instrument. Nowadays there's electronic equipment available like the TESTO 352-2 (plus flue gas sensor 352-2) that makes it much easier to measure all relevant data (incl. temperature).

Spare parts

P/N	Name	Neptune 5	Neptune 7
62730	Safety valve compl. - 200 bar; 1~	●	●
65056	Repair kit - CSB (5-25, 5-27, 5-42, 5-49, 7-25)	●	●
1119310	Valve set (4x)		●
1119570	Repair kit, gasket		●
1119571	Repair kit, gasket		●
1119820	Repair kit for oil sealing		●
107120700	Repair kit for pressure ring		●
301000911	Safety valve compl. - 250 bar; 3~	●	●
301001130	Extension kit: hose- + cable-reel	●	●
301001131	Extension kit: cable-reel	●	●
301001146	Piston kit (dia. 18)	●	
301001147	Piston kit (dia. 20)	●	
301001148	Piston sealing kit (dia. 18)	●	
301001149	Piston sealing kit (dia. 20)	●	
301001150	Oil sealing kit	●	
301001151	Support ring kit (dia. 18)	●	
301001152	Support ring kit (dia. 20)	●	
301001153	Valve kit for pump (6x)	●	
301001195	Repair kit - CSB (5-57, 7-63)	●	●

Table 9.2: Spare parts

Table 9.2 includes all important repair kits and parts necessary for service and maintenance. For a detailed view have a look in the spare parts list of Neptune 5 / 7 (P/N 301001054).

Further material

P/N	Name	Neptune 5	Neptune 7
41455	Grease (-15 °C till +130 °C), 50 g tube	●	●

Table 9.3: Further material

To lubricate sleeves, O-Rings and other parts always use the grease in table 9.3. **Never use grease containing silicon for parts that get in touch with water!**